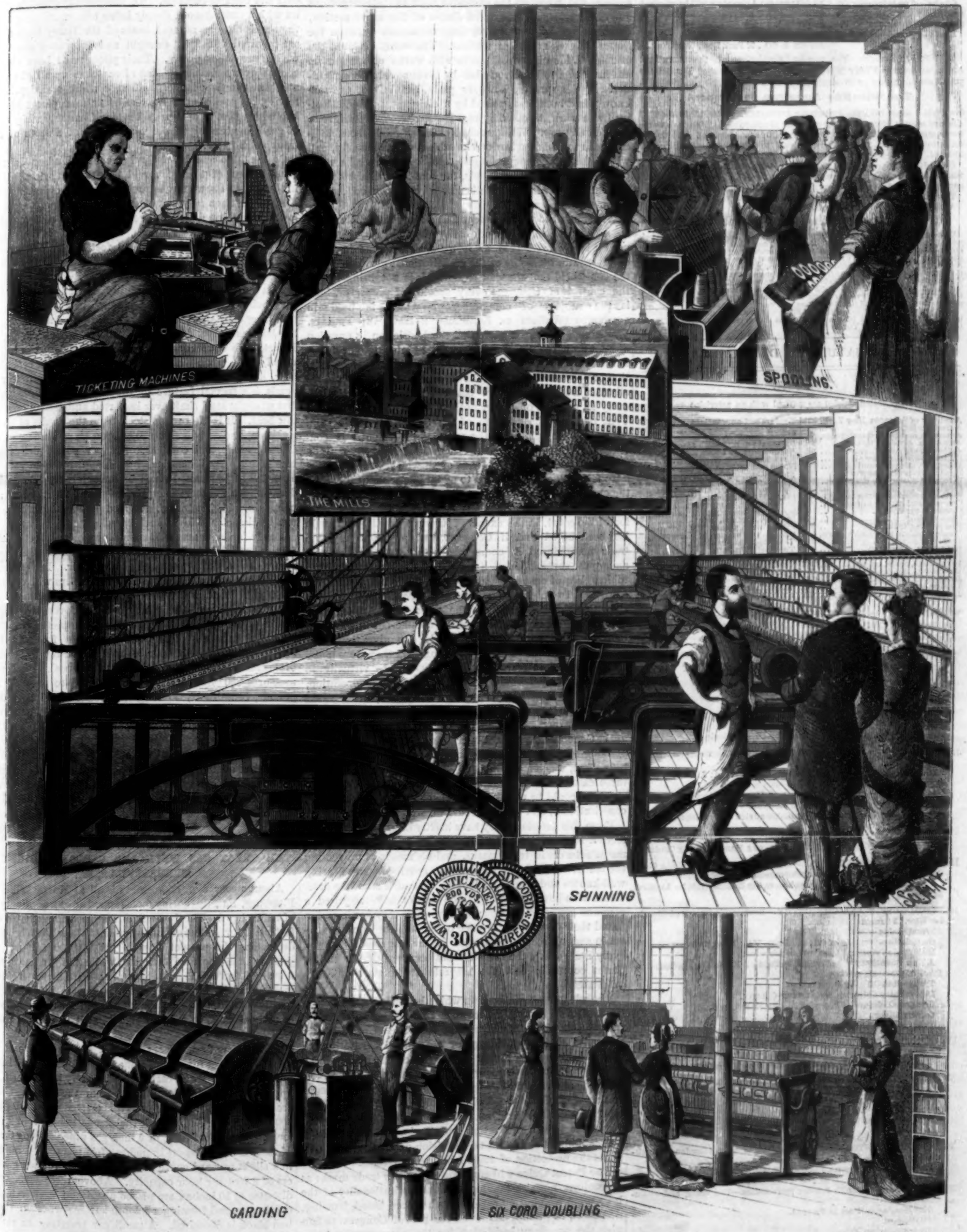
SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY AND MANUFACTURES.

Vol. XLI.—No. 23. [NEW SERIES.] NEW YORK, DECEMBER 6, 1879. [$3.20 per Annum. [POSTAGE PREPAID.]



MILLS OF THE WILLIMANTIC LINEN COMPANY.—[See page 357.]

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT
NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, postage included..... $3 20
One copy, six months, postage included 1 60

Clubs.—One extra copy of THE SCIENTIFIC AMERICAN will be supplied gratis for every club of five subscribers at $3.20 each; additional copies at same proportionate rate. Postage prepaid.

Remit by postal order. Address
MUNN & CO., 37 Park Row, New York.

☞ To Advertisers.—The regular circulation of the SCIENTIFIC AMERICAN is now **Fifty Thousand Copies** weekly. For 1880 the publishers anticipate a still larger circulation.

The Scientific American Supplement

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, with handsome cover, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, postage paid, to subscribers. Single copies 10 cents. Sold by all news dealers throughout the country.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, postage free, on receipt of *seven dollars*. Both papers to one address or different addresses, as desired.

The safest way to remit is by draft, postal order, or registered letter. Address MUNN & CO., 37 Park Row, N. Y.

Scientific American Export Edition.

The SCIENTIFIC AMERICAN Export Edition is a large and splendid periodical, issued once a month. Each number contains about one hundred large quarto pages, profusely illustrated, embracing: (1.) Most of the plates and pages of the four preceding weekly issues of the SCIENTIFIC AMERICAN, with its splendid engravings and valuable information; (2.) Commercial, trade, and manufacturing announcements of leading houses. Terms for Export Edition, $5.00 a year, sent prepaid to any part of the world. Single copies 50 cents. ☞ Manufacturers and others who desire to secure foreign trade may have large, and handsomely displayed announcements published in this edition at a very moderate cost.

The SCIENTIFIC AMERICAN Export Edition has a large guaranteed circulation in all commercial places throughout the world. Address MUNN & CO., 37 Park Row, New York.

NEW YORK, SATURDAY, DECEMBER 6, 1879.

Contents.

(Illustrated articles are marked with an asterisk.)

Academy of Sciences, New York,	353	Masters and apprentices	356
American industries	357	Mining tunnel, Colorado	362
American institute of architects,	353	Motor, tramway, new*	354
Anaconda, crushed by an	354	National public health assoc'n.	353
Astronomical notes	356	Natural history notes	359
Commercial enterprise	357	Nearsightedness	361
Dairy fair, international	360	Notes and queries	363, 364
Dead, preservative of the	359	Projectile, military, new	360
Electrical generator, Edison's	360	Reading room, British museum	361
Fire losses	362	Red Sea, where Israelites cross'd,	354
Fish, cross-breeding among	360	River, Manchester and Liverpool	354
Gas well and carbon factory	353	Screw driver, improved*	356
Gelatine, purifying	361	Slag boiler covering	361
Glass tubing*	361	Steamer, Cunard, new	358
Haymaking, artificial*	356	Steam fitter, young, hints to*	355
Hughes micro. and Blake trans,	360	Telegraphic system of the world	362
Ibex, the*	359	Telegraphy in France	362
Industries, American	357	Towboat, Western	352
Inflammable goods, a ban on	353	Towing, steam, on the Erie canal	360
Inventions, agricultural	361	Trade mark decision, a	352
Inventions, mechanical	358	Tribute, handsome, a	358
Inventions, miscellaneous	357	Volcanic products of the Pacific	359
Letters patent	362	Wagon hardware trade	358
Linen Company, Willimantic*	351		

TABLE OF CONTENTS OF

THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 205,

For the Week ending December 6, 1879.

Price 10 cents. For sale by all newsdealers.

I. ENGINEERING AND MECHANICS.—Shafting, Couplings, and Hangers. 9 figures.
Machinery from an Insurance Point of View. By A. J. BATES. (Continued from No. 204.)
How to Prevent the Rapid Spread of Fire. Architectural remedies for the rapid spread of fire through buildings.
Principles of Horseshoeing. Valuable advice by Dr. GEORGE FLEMING, V.S., London.
Shingle Manufacture.
Advantages of Cumberland, Maryland, as a Manufacturing Center.

II. MINING AND METALLURGY.—The Lexington Oil Belt, Santa Clara County, California. Recent developments. Promising wells.
The Sutro Tunnel. An address before the Bullion Club, by ADOLPH SUTRO.

III. TECHNOLOGY AND CHEMISTRY.—Bracewell's Improved Bleaching Kier. 2 figures.
Wood Stains.
On Gelatino-Bromide of Silver. By D. VAN MONCKHOVEN.
Heliotypic Printing Plates. How prepared.
A New Quantitative Analytical Method of Extensive Applicability. Prof. A. Classen's process.
Turkey Red Oil. By G. STEIN.
Determining Sulphur. By ALBERT COLSON.
Compound Nature of Phosphorus. By N. LOCKYER.
Spongy Silver.
Fast Scarlet without Cochineal.

IV. ELECTRICITY, LIGHT, ETC.—Carre's Di-electric Machine. 2 figures. 1. The friction machine. 2. The di-electric induction apparatus.
The Most Powerful Telescope in Existence. By E. NEISON.

V. MEDICINE AND HYGIENE.—Curious Case of Loss of Personal Identity.
The Eucalyptus and the Pine Considered in Relation to their Sanitary Properties. By C. T. KINGZETT.
Neuralgia Cured by Nerve Stretching.
Anti-fat.

VI. NATURAL HISTORY.—The Orang-Outang of the Garden of Acclimatization, Paris. 1 full page illustration.
South African Baboons. Notes by H. N. MOSELEY.
The Orang-Outang. 11 figures. The orangs in Paris.—Orang-outangs in Borneo.—The orang's fighting propensities.—The orang and evolution.
The Homing Instinct in Pigeons.
Phylloxera.
Hedge Hog and Viper.

VII.—ARCHÆOLOGY.—New Explorations of the Ruins at Palenque, Mexico. By M. F. MALER. 3 figures.

THE TRADE MARK DECISION.

The three cases of the United States against Emil Steffens, Adolph Witteman, and W. W. Johnson—all prosecutions for violations of the trade mark laws embodied in sections 4,937 to 4,947 of the Revised Statutes—were decided by Justice Miller in the United States Supreme Court, at Washington, November 17. The lower courts had been divided in opinion as to the constitutional power of Congress to legislate on this subject. It was maintained by counsel who sought an affirmative answer to the question that two clauses in the Federal Constitution furnish sufficient warrant for the legislation in dispute, namely, the 8th clause of section 8, article 1, which provides that Congress shall have power to pass laws to promote the progress of science and the useful arts by securing for limited times to authors and inventors the exclusive right to their inventions and discoveries; and the third clause of the same section, empowering Congress to regulate commerce between the States and with foreign nations. The court declared the attempt to identify trade marks with works of authorship and invention to be surrounded by insurmountable difficulties. If the symbol, however plain, simple, old, or well-known, had been first applied by a claimant as his distinctive trade mark, he could by registrations secure the right to its exclusive use. While such legislation might be a judicious aid to common law on the subject of trade marks, and within the competency of legislatures whose general owners embraced that class of subjects, the court was unable to find any such power in the constitutional provision concerning authors and inventors.

With regard to the argument that a trade mark is used to identify a particular class or quality of goods, and that as so used it is a valuable aid or instrument of commerce, and comes within the scope of the constitutional provison cited, the court held that the clause quoted does not bring within the control of Congress every species of property which is the subject of commerce, or which is used in commerce (Wallace *vs.* Louisiana, 8 How. 73; Paul *vs.* Virginia, 8 Wall. 168), and that the legislation in question did not limit the use of trade marks to inter-state or international commerce, as it should do if based on the constitution or provision quoted in its support. If it referred to all trade and to commerce between all points, it was obviously an exercise of power not conferred upon Congress. That this was the purpose of the legislation in question seemed, in the opinion of the court, to be evident. It contemplated the establishment of a universal system of trade mark registration for the benefit of all who had already used a trade mark, or who wished to adopt one without regard to the character of the trade to which it was to be applied or to the locality of owner. Such legislation was, in the opinion of the court, in the excess of Congressional power. It had been urged that if Congress had power to regulate trade marks used in commerce with other nations and among the several States, its legislation, so far as it related to that class of cases, should be held valid; but to this the court held two objections: First, that there was nothing to show that the trade marks in the three causes under consideration were used in that kind of commerce; and, second, that it was not within judicial province to give the words used by Congress a narrower meaning than they were manifestly intended to bear. To do so would be virtually to make a law which would be only partial in its operation, and which would complicate rights which parties would hold in some instances under acts of Congress and in others under State law. The question of the treaty-making power of the General Government over trade marks, and the duty of Congress to pass any laws necessary to carry such treaties into effect, was left untouched. The only question in the three cases under review was whether the statutes of 1870 and 1876 could be upheld in whole or in part as valid and constitutional, and that the court answered in the negative.

From this decision many have hastily inferred that no protection remains for the property rights of merchants and manufacturers in trade marks, and no means of preventing the markets from being flooded with spurious wares bearing well-known and respected labels. But such is not the case. Those who have been using trade marks have acquired a common law right to them; and in case they are counterfeited their owners can at once bring suit at equity to restrain and to recover damages in the courts of any and every State where the infringement occurs; or in the United States courts in case the litigants are citizens of different States.

The advantages of the laws which have been declared unconstitutional lay simply in their enabling all suits for infringements of trade marks to be brought in United States courts, and in providing for a formal registration of trade marks by the Patent Office, the certificate of which was accepted in all the courts of the country as prima facie evidence of ownership. Another advantage of such registration arose from the facility it afforded for determining whether a desired trade mark had been previously adopted by another, thus preventing unintentional infringements.

It is proper to add that this decision does not in any way affect the protection of trade labels by copyright.

The Patent Office will continue to register trade marks as heretofore, notwithstanding the unconstitutionality of the laws upon which such registration has been based, trusting, doubtless, to prompt action on the part of Congress to furnish the necessary legislation for the permanent continuance of the work. Should this fail, Congress will no doubt provide by appropriate legislation the means for returning the fees received for the 8,000 or more trade marks thus far registered.

A WESTERN TOW-BOAT.

The Pittsburg coal firm of W. H. Brown & Co. have just completed and added to their fleet of tow-boats the Harry Brown, a typical Western river tow-boat, being the most powerful and complete high pressure craft of its kind afloat. The peculiar and hazardous conditions which attend the safe delivery at New Orleans of a "tow" (from 200,000 to 500,000 bushels) of Pittsburg coal cannot be fully shown here, nor are they likely to be clearly comprehended by any but river men. The first 500 miles below Pittsburg comprises a succession of tortuous windings, of shoals and "riffles," and bars and counter-currents. To successfully run this gauntlet with a cumbersome, deeply laden tow, containing tens of thousands of tons of coal, boats of the Harry Brown type are required, with light draught and enormous steering as well as propelling power. Their pilots must have absolute control over a rigid mass that often takes up all the available water in the channel, both as to width and depth. To render this possible the Western river man places his boat behind his fleet of coal-laden boats and barges, and by means of great hawsers binds the whole mass of a score of craft into a solid "tow."

On the Ohio and Mississippi rivers the Hudson River or canal system of towage would be utterly useless. Hence in the Harry Brown's construction features unintelligible to Eastern boatmen may be noted. Her dimensions are as follows: Length on deck, 210 feet; beam, 42 feet, over all, 52 feet; hold, 5½ feet. Engines, one pair, high pressure, 26 and $\frac{8}{10}$ diameter of cylinders, 10 feet stroke. Seven steel boilers, 40 inches diameter and 28 feet long, furnish the necessary steam, at 170 pounds pressure, test pressure of boilers being 260 pounds hydraulic. An auxiliary or "nigger" boiler, 38 inches by 10 feet, supplies steam for engines operating capstans, etc. The wheel, located at the stern of the boat, is 26 feet 4 inches in diameter, length of buckets, 32 feet, each bucket or paddle being 32 inches in width. The wheel shaft, upon which the greatest strain is brought to bear, and upon which the safety of boat and tow depends, is a special feature of the Harry Brown, being the first wrought steel shaft ever imported and used upon a river tow-boat. It is of crucible steel, from the works of Krupp, at Essen, and weighs alone 20,600 pounds; with flanges, etc., 40,000 pounds; and cost 13 cents per pound delivered in New York. Its dimensions are: Length, 36 feet 7 inches; diameter at journals, 13 inches; in center, 15 inches. Rudders, four in number; one pair, balanced, 25 feet long; one pair, wing, 14½ feet long; actuated by steering wheel, 12½ feet in diameter, with 16 inch barrel.

Ready for business the Brown draws only 3 feet 4 inches forward and 3 feet aft, a great desideratum, enabling her to return to port during a season of low water. In service, and to maintain steam at 170 pounds, the boilers will evaporate 5,000 gallons of water per hour, and the engines evolve 1,750 horse power. This boat, with a favorable stage of water—9 to 12 feet at Pittsburg—is expected to take to New Orleans and other Southern ports from 28 to 30 loaded coal boats, say 600,000 bushels, or the total output of 6 acres of a 4½ foot vein of Pittsburg coal. Such a tow measures 850 by 200 feet, and reduced to tons of 2,000 pounds, contains 22,800 tons. A loaded coal boat draws from 7½ to 8 feet, a barge from 6 to 7 feet. The former's load is 23,000 to 25,000 bushels, the latter 12,000 to 13,000 bushels.

In the Harry Brown is embodied every feature that long experience could suggest or money procure to make her the model of her class. At present prices for iron, etc., she could scarcely be built for $60,000, though her actual cost was $50,000.

THE GREAT GAS WELL AND CARBON FACTORY AT MURRAYSVILLE, PA.

About a year ago, in boring for oil at Murraysville, near Pittsburg, Pa., the boring tools tapped an extraordinary vein of natural gas. The flow was estimated at about 50,000 cubic feet per hour. Recent measurements show that instead of decreasing, the present flow is fully 10,000 feet per hour greater than the first estimate, while the pressure at the mouth of the well is 90 pounds per square inch. This enormous quantity of natural fuel has, up to this time, been mostly wasted, but will soon be utilized for the manufacture of carbon black, or "lamp" black, as it is more commonly called.

A Pittsburg firm, Messrs. Sherriff & Hazely, are at work upon a contract for the machinery and fittings of what will probably be the largest carbon black factory in the world. The appliances for collecting the soot from the Murraysville gas are the following: Near the well is erected a frame building, 300 by 175 feet, and into it the gas is led in four parallel lengths of 250 feet each, of 2 inch gas pipe. Along the sides of these are fitted short branches of ½ gas pipe, terminating in a slight upward curve and tipped with ordinary gas burners of 6 foot per hour capacity. Above these burners, at a distance of 10 inches, are placed a series of cast iron plates, contiguous and forming a smooth surface whereon the carbon black is deposited. A small car traveling on rails laid between burners and plates, and furnished with a scraping device, plies forward and back every ten minutes during the twenty-four hours. This carriage is propelled by steam

power, operating through wire rope and suitable gearing, drums, etc. The smoke or carbon black is scraped into pans hung upon the car, and these are dumped at each end of the route into receptacles, which are in turn emptied and deposited in the purifying and packing house. After simply removing cinders, etc., by passing through sieves, the soot is ready for the market. The daily product of this plant will be ½ pound carbon black per burner, *i. e.*, 2,000 pounds, there being 4,000 burners. Another plant of 4,000 burners is to be erected, the 8,000 burners to turn out two tons of carbon black daily. There will then still be 12,000 cubic feet of gas go to waste hourly, sufficient to light a good sized town. The owners of the Murraysville gas well refused $20,000 for it from the Edgar Thomson Steel Works, of Pittsburg, who wanted to connect the well with their works by a gas main, about 15 miles in length.

The phenomenon of an invisible gaseous substance issuing from the earth made visible, condensed into solid form, and packed up for market is strikingly illustrated in this establishment. The gas as it issues from the ground is unseen, but a given volume of it is found by chemical analysis to consist approximately (we do not mean to say absolutely and exactly) of twenty-four parts by weight of carbon and four parts of hydrogen; in other words, a quantity of the gas that weighs 28 pounds is made up of 24 pounds of carbon and 4 pounds of hydrogen. This hydrogen seems to have the power of imprisoning and concealing the carbon from human view. But carbon is carbon, whether in this gas or existing in the carbonic acid that gives pungency and effervescence to the soda water we drink, or in the lamp flame imparting its brilliancy, or in the sparkling diamond, the hardest of substances and the purest form of carbon.

The carbon that comes up in the gas well is rendered visible by separating the hydrogen from it, which is done by the heat of the flame. The hydrogen contained in the gas is burned up by uniting with the oxygen of the air, but only a portion of the carbon is burned; the unconsumed portion of the carbon, liberated by the burning of its hydrogen, rises up against the plates, where its sticks fast until scraped off as described.

NEW YORK ACADEMY OF SCIENCES.

The Chemical Section of the New York Academy of Sciences met Monday, Nov. 9, Prof. Newberry in the chair.

Mr. Kunz exhibited a specimen of fluorspar, one half of which was of an amethyst tint, and which had been fashioned into a rude ornament. It was found near Elizabethtown, Harden county, Ill., where fluorspar occurs in immense deposits.

He also exhibited a rock crystal pitcher of exquisite workmanship. It was made of an unusually large piece of crystal, and is without a flaw. Messrs. Tiffany & Co., to whom it belongs, value it at about six hundred dollars.

The paper announced for the evening was on the

ADULTERATION OF FOOD,

by Prof. A. R. Leeds, of the Stevens Institute of Technology, who had undertaken the investigation of a large number of articles of domestic consumption as a part of the work devolving upon him by his connection with the New Jersey Board of Health.

Prof. Leeds prefaced his remarks by the reassuring statement that many of the fears awakened in the public mind by the discussions in the newspapers concerning the deleterious or even poisonous character of various substances said to be used in the adulteration of many articles of food are entirely groundless, and that the most searching analyses in his own laboratory failed in nearly all cases to reveal their presence, although the articles tested were for the most part purchased at the meanest shops, whose custom consisted of the poorest class of the community. The adulterations found consisted mostly of substances harmless in themselves and used for the purpose of increasing the weight or bulk of the articles sold. Such adulteration must of course be branded as fraudulent; but while it is an offense against public morality, it is not one against public health. The following are some of the articles examined.

It has been objected to by some that bread is adulterated with potatoes, but this addition, so far from being injurious, actually improves the quality of the bread. A few samples of bread contained very small quantities of alum, said to be used for the purpose of making it whiter and lighter. Some contend that a very little alum is not injurious because it is rendered inert by the phosphate of lime contained in the flour, and also by the acids of the gastric juice. Not the slightest trace of copper was revealed in the bread examined by the most searching methods of analysis. Saleratus was found in nearly all cases to consist, as it should, of perfectly pure bicarbonate of soda; but cream of tartar was found to be adulterated in some cases as much as sixty per cent. with terra alba. Baking powders, which should consist of bicarbonate of soda and cream of tartar in suitable proportions, kept from combination by the admixture of a little starch powder, were found to vary greatly in the amount of their effective constituents. All the sugars examined were found to be perfectly free from all injurious substances, while the cheaper grades of sirups contained considerable glucose, a substance much inferior in sweetening power to cane sugar. No trace of strychnine, cocculus indicus, or other poisons popularly supposed to be used in the manufacture of liquors, beers, etc., were discovered. No sulphuric, nitric, or hydrochloric acids were found in vinegar. All the samples examined derived their activity from acetic acid, of which, however, they contained different proportions. In other words, some of them were more or less diluted with water. None of the samples of milk examined were found to contain any more serious adulterant than water. A diligent search was made to find brightly colored cucumbers whose tint would seem to indicate that copper had been used to make them more attractive; in none of them, however, was even the faintest trace of copper found to be present. Canned goods were found to be free from all deleterious substances. Spices procured from various sources differed greatly in strength, and all contained foreign substances increasing their bulk and diluting their pungency. Different samples of teas examined chemically and under the microscope revealed the fact that they were adulterated by leaves of other plants to a very great extent. Some of the cheapest kinds, selling (say) for 35 cents a pound, contained no tea leaves whatever. Candies were found to be much more free from injurious substances than the public has been led to believe. Many of them contained a large admixture of glucose, but the coloring matters used were comparatively harmless. In some of them aniline colors were used, which, although poisonous, cannot be fairly so-called in the very minute quantities necessary to color candy.

Prof. Leeds also examined green wall papers for arsenic, and exhibited several tubes containing arsenic extracted from them. These papers must be condemned as highly injurious, especially as the arsenic is but loosely applied to the surface and is easily diffused through the air, whence it finds its way into the lungs. One specimen of arsenic shown was extracted, curiously enough, from a little green Christmas tree candle.

He concluded his paper by remarking that three things were necessary to keep the practice of adulteration in check: a strong public sentiment kept aroused by the public press; the enactment of stringent laws; and the appointment of competent persons to execute them.

Mr. Kunz remarked that a firm in New York city made a fortune by selling cocoanut shells to the manufacturers of spices, who ground them up to increase the bulk of their products.

Capt. Blake stated that it was perfectly impossible to buy pure tea at 35 and 50 cents a pound, seeing that a good article costs $1 a pound at Fouchow. C. F. K.

The New York Academy of Sciences met Monday evening, November 17, President Newberry in the chair. A large number of minerals was exhibited, among which a rough diamond from Brazil and a diamond crystal from South Africa attracted much attention. They were shown by Mr. Kunz, expert in gems at Tiffany & Co.'s. The first paper of the evening was on some

RECENTLY DISCOVERED CAVES,

by Prof. Newberry. A great many caves having been discovered in this country within the last few years, it may not be wholly devoid of interest to those who have not made them the subject of special study, to describe the method in which they were formed. An excellent illustration is furnished by the triangular plateau of Central Kentucky, which, like all the formations abounding in caves, consists chiefly of limestone rock. This rock, by its numerous fissures and joints, as well as by its solubility in water charged with carbonic acid, is peculiarly liable to be attacked by the action of rain water, which always contains a small percentage of carbonic acid. The surface of this plateau is always dry, and no rivulet or brook is found upon it. The rain almost immediately finds its way to the underground channels which previous rains have hollowed out, and continues the work of excavation. At first the natural joints or seams of the rock are widened into fissures, and then, where some portions are more soluble than others, these fissures are further hollowed out into caves, some of them twenty and thirty and even more feet long, whose ceilings and floors are adorned with beautiful stalactites and stalagmites deposited from solution as the water containing carbonate of lime slowly filters in and evaporates. In this way immense tracts of country, where limestone is the principal formation, are literally honeycombed with subterranean caves. The Mammoth Cave itself is a member of such a system of caves. In many cases, especially in the region of the Upper Missouri, and between the Rocky Mountains and the Sierra Nevada, the same volcanic action that upheaved the limestone also brought up from below springs containing metallic substances in solution. These substances were then deposited in the fissures of the rock and also on the walls and floors of the caves. The most common are ores of iron, such as limonite, and of lead, such as galena. Many fortunes have been made and lost again by those who made it their business to explore these limestone regions for caves containing lead. The method followed is that of simply sinking wells at intervals and examining the excavated minerals. In this connection Dr. Newberry told an amusing story of an enterprising individual who had spent several fortunes acquired in this way. When at length his purse was nearly exhausted, he spent his time driving around the country to examine the wells dug by others in the hope that his superior experience would enable him to recognize signs of mineral deposits which had escaped the eyes of others. He succeeded in purchasing an unpromising looking well for a hundred dollars, and, upon exploring it, he found sufficient indications to warrant him in buying up considerable land around. When he had established his title, he descended his well alone to continue his search. To his great surprise, he struck a passageway leading into a cave that contained thousands of tons of lead ore. He jumped down into it, stuck his candle into the sand, and began to reflect how he could apply his new fortune to a better purpose than his former ones. His pleasant reverie was, however, brought to a sudden close. His last candle went out, and he was left in darkness so dense that he could not find the hole through which he had entered. After many fruitless attempts he finally thought of the following very sensible method. As he tried each spot along the walls of the cave by raising his pickax above his head and feeling his way with it, he marked the place with a stone. He finally regained the upper regions hungry and faint, after an imprisonment of forty-eight hours. Notwithstanding his good resolutions, the new fortune did not last much longer than the old ones.

The caves found between the Rocky Mountains and the Sierra Nevada, in the region of the lost mountains, so-called because short mountain chains rise there at intervals from a perfectly level surface, are distinguished by the fact that they contain the precious metals associated with iron and lead: gold with iron pyrites and silver with galena. The celebrated Emma mine and the Eureka are examples of this kind of deposit. The fluctuations in the value of mining stocks of this kind depend upon the beautiful uncertainty as to the continuity of the deposit. It may "pinch out"—that is, become so insignificant at any time that it will not pay to work any longer; and then again it is just as likely that new openings into rich deposits may be found.

The next paper was on a new proof of the

SUBSIDENCE OF OUR COAST,

by Prof. G. S. Martin. He exhibited specimens of peat that had been washed ashore at Long Island. They were similar to those found by Scudder on the Nantucket beach, and by Dall at Nahant. Their appearance indicated that they had been burrowed into to such an extent as to cause them to be broken by the action of the waves and detached from ancient peat bogs, whose edges crop out along the coast under the surface of the sea. These bogs, which belong to the period of glacial, or perhaps to that of terrace, elevation, thus furnish an additional evidence of the subsidence of portions of our coast extending through long periods of time.

C. F. K.

The American Institute of Architects.

The thirteenth annual convention of the American Institute of Architects began in this city, Nov. 19, nearly all the chapters being represented. In his annual address, President Walter spoke very hopefully of the influence exerted by the organization in raising public opinion to a higher level in all matters pertaining to architecture. Works of recent date exhibit, he said, a freshness in their architectural handling that seems to indicate the advent of a new era in the art of design. The manifest tendency of architects to break away from the trammels of conventional rules, and to make style subservient to the spirit of the age, indicates a progress in the development of independent thought hitherto unknown. Architecture, both in this country and in Europe, is obviously in a transition state. What may be the result remains to be seen; if, however, architects are careful to design their works on true æsthetic principles and in conformity with the science which underlies the art, it is not likely to be regretted that they show a disposition to do their own thinking. Classic forms and combinations are everywhere yielding to more ornate compositions bearing the names of fashions of building having no trace whatever of paternity, either ancient or modern. Particular stress was laid upon the claims of domestic architecture, particularly with reference to improvements in processes for warming and ventilating dwelling houses, the disposition of sewer gas, drainage, and other sanitary questions.

THE NATIONAL PUBLIC HEALTH ASSOCIATION.

The annual convention of the American Public Health Association took place at Nashville, Tennessee, Nov. 18. Over two hundred members were present at the first session, including nearly all the leading sanitarians of the country. The programme announced some weeks since in this paper contained many subjects of interest and importance to the whole country; and there is reason to expect large public benefits to flow from the united attention brought to bear upon the great questions of public sanitation treated in the numerous papers and discussed by the members.

THE description of Ward's steam generator, on page 333, of current volume, states that the generator furnishes steam to a single engine. Mr. Ward informs us that it supplies steam for two engines, 9¾ cylinders, 36 inch stroke, making 35 revolutions per minute.

A Ban on Inflammable Goods.

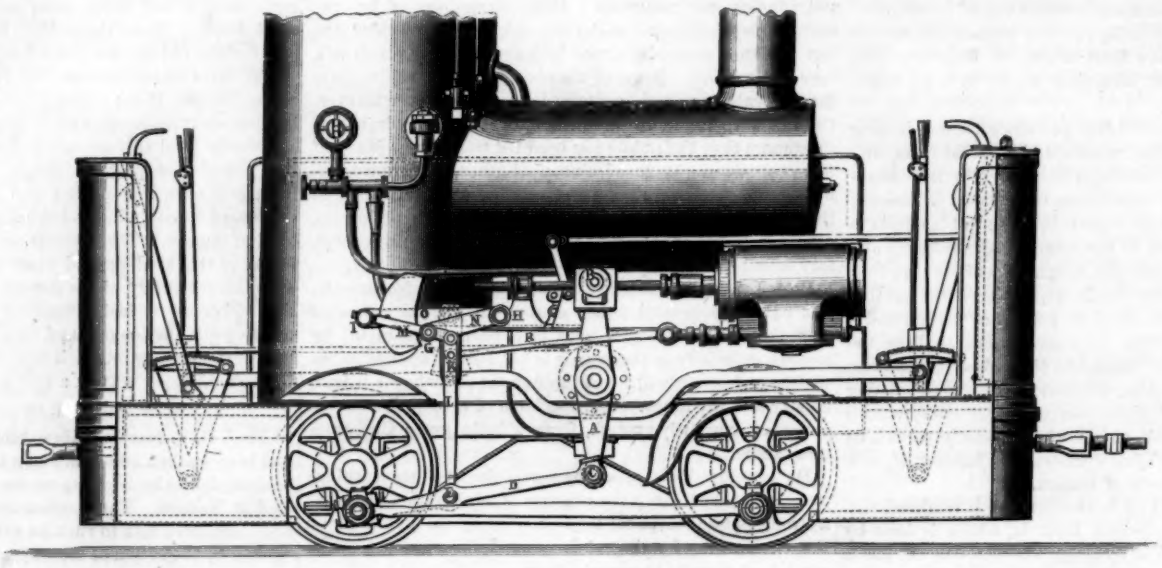
In consequence of recent disclosures the directors of the North German Lloyd's Steamship Company have decided to refuse transportation on their vessels to the class of heavy French silks which are so weighted with chemicals and oils as to cause danger of spontaneous combustion.

A HANDSOME TRIBUTE.—The Lords of the British Admiralty have given orders for the making of a handsome piece of furniture from the timbers of the old Arctic exploring ship Resolute for presentation to Mrs. Grinnell, the widow of the late Henry Grinnell, of New York, who fitted out at his own expense two expeditions for the search of Sir John Franklin.

NEW TRAMWAY MOTOR.

The accompanying engravings represent a very successful little motor used in propelling tramway cars. In the month of March, 1877, sixty-five locomotives of this style were in use in Strasbourg, Hamburg, Geneva, Paris, Milan, Rome, Madrid, and Turin. It is stated that trials made with this and other locomotives in Berlin, Cologne, Porte, etc., resulted in a victory for the Brown locomotive.

The movement of this machine is very quiet and regular, the mechanism is simple, and the locomotive can be attended to by a single person. The exhaust makes little noise, in fact is hardly perceptible. The gentleness of the action is due to the transmission of the motion by the lever, A, which gives a perfect equilibrium to the moving parts. There are controlling levers at both ends of the locomotive, so that in whatever direction the train moves the engineer can always sit in front. The fire box is furnished with an inclined grate, upon which the descent of the coal is very regular. A single charge of coal lasts about one hour.

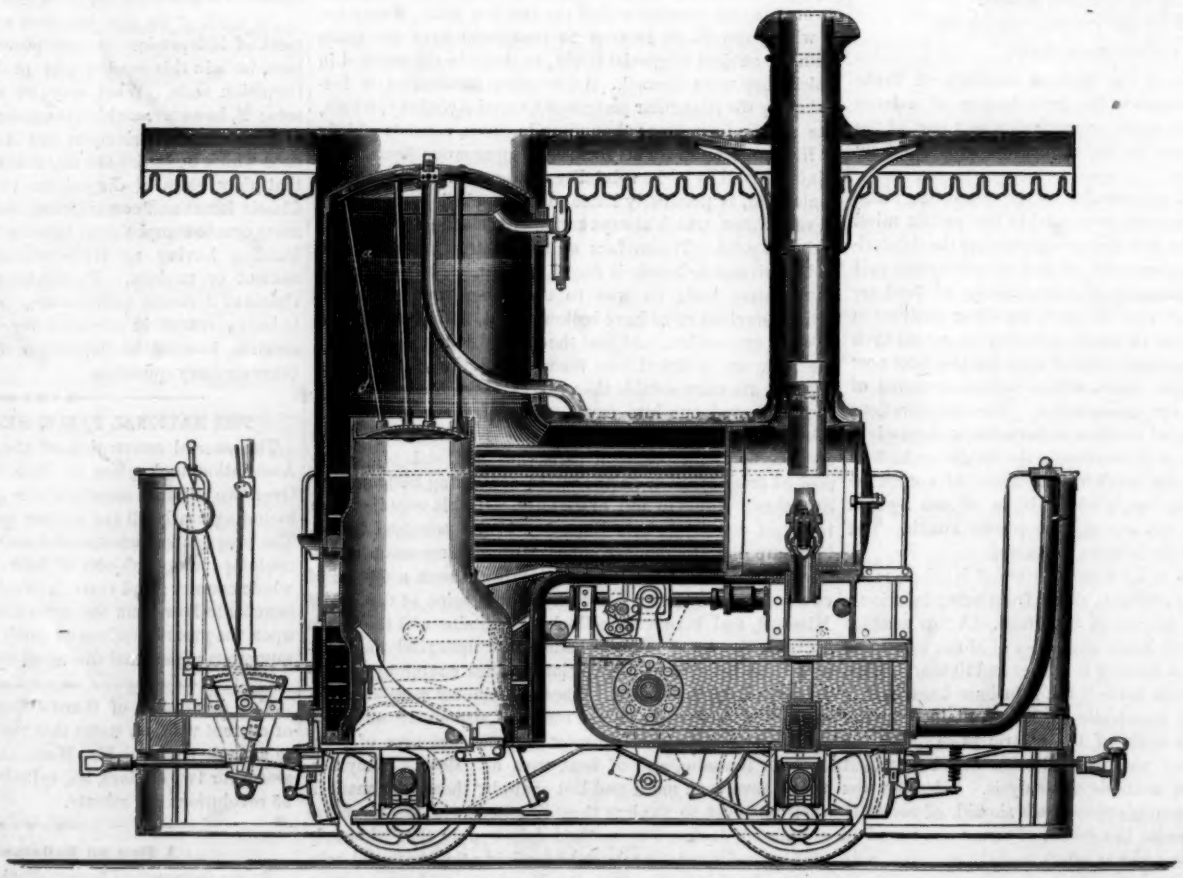


NEW TRAMWAY MOTOR.

The boiler is of the style generally used in small locomotives, but the vertical part is so large that the level of the water can vary about nineteen and a half inches, which corresponds to about seventy-five gallons. The boiler is filled at the station, and the engineer need not waste time during the trip to refill the boiler, and it is therefore possible for a single person to run the engine, as has been proved at Strasbourg. The distribution of the steam in the cylinders is obtained by means of peculiar mechanism which receives its motion directly from the crank. By this means the expansion can be regulated to any desired degree. With a boiler pressure of 150 lb., the steam may be cut off early in the stroke. In Strasbourg and Beziers, where the grade is from one to one and a quarter inches, these machines draw four cars with 200 to 250 passengers. In order to diminish the noise of the exhaust steam it is allowed to pass into a vessel situated between the cylinders and containing water. The pressure in this vessel is almost constant, which causes the steam to escape continuously and with noise. The chimney consists of two sheet iron cylinders, between which there is a packing of mineral wool, which prevents all vibration.

The steam passes from the vessel between the cylinders into a series of short tubes placed in the chimney. At every stroke of the piston a good draught is obtained, which superheats the smoke and gas, and makes it invisible at the top of the chimney.

If the normal atmospheric temperature is higher than 50°, this method will answer, but in winter a surface condenser, over which the steam passes after leaving the cylinder, is required. The axle boxes are constructed so that the smallest curves can be turned without difficulty.



TRAMWAY MOTOR—LONGITUDINAL SECTION.

A COAT of gum copal varnish applied to the soles of boots and shoes, and repeated as it dries until the pores are filled and the surface shines like polished mahogany, will make the sole waterproof, and it lasts three times longer.

Where did the Israelites Cross the Red Sea?

This query, some explorer has suggested, may be solved with our present appliances for fathoming depths. The *Christian at Work*, alluding to the subject, says that three or four theories prevail as to the spot the crossing was made.

The Arabs say several miles south of Suez, between the promontory of Atakah and Ayan Musa, where the Red Sea is about ten miles wide. This view is strengthened by the Bible reference to the walls of water on both sides of the army, but, as Dr. Schaff says, "it is impossible that six hundred thousand armed men, with women and children, and their herds of cattle, could have crossed so great a distance in one night without a prodigious accumulation of miracles." Another theory places the crossing at the head of the gulf, a little north of Suez. Here is a shoal channel, four miles long and less than half a mile wide, in which there are several islands and sand banks, bare at low water. The Israelites might easily have crossed here; indeed, so strong is the tide that a strong east wind—such as we are told Jehovah caused to "blow all the night"—would have made the walls of water of which the Bible speaks. This place is generally favored by modern biblical critics. The reader will recall the fact that it was here that Napoleon, deceived by the tidal wave, attempted to cross in 1799, and, in his own words, nearly became a second Pharaoh. As we have said, it is not likely that any of the rusty old chariots, nor so much as a broken axle or harness buckle, will ever be brought to light. Possibly some papyrus may be found with a private record of the wonderful event. But the search for this would be about as uncertain as the hunt after the precious stones that Aaron wore in his breastplate.

Proposed River between Manchester and Liverpool.

A meeting has been held in Manchester for the purpose of considering the expediency of the proposal for the construction of a tidal navigation for seagoing steamers between Manchester and Liverpool. At this meeting Mr. Hamilton Fulton, the engineer, explained the nature of the proposal, and stated that the length of the channel between Manchester and Liverpool would be about 36 miles. The minimum width of the navigation would be 200 feet, and the minimum depth at low water spring tides would be 10 feet, or about 2 feet more water than exists at low water over the bar at the mouth of the Mersey. A basin would be provided at the Manchester end of 81 acres with 16,000 lineal feet of well constructed wharves, and all requisites for shipping accommodation on a large scale. The estimated cost of the undertaking is £3,500,000. Mr. George Hicks, of Manchester, presented a statement as to the probable revenue, which, if realized, would give a large return upon the proposed outlay.

Owing to the inability of several members of Parliament and others to attend, the further consideration of the subject was adjourned.—*Warrington Guardian.*

Crushed by an Anaconda.

One of the most intrepid wild beast tamers in Europe, Karolyi, a Magyar of colossal stature and extraordinary physical strength, has recently fallen a victim to a dread contingency of his perilous profession. He was performing before a crowded audience in Madrid the other day one of his most sensational feats, which consisted in allowing a huge boa constrictor, over twenty feet in length, to enfold his body in its tremendous coils, when suddenly a piercing cry escaped him, which was greeted by the public with a round of applause, under the supposition that its utterance constituted a part of the performance. It proved, however, to be the outcome of a strong man's death agony. The gigantic snake had tightened its coils and crushed poor Karolyi's life out of him with one terrific squeeze. As his head fell back and his eyes became fixed in a glassy stare, the plaudits died away, and were succeeded by the stillness of utter consternation. The snake and its lifeless victim swayed for a second or two of inexpressible horror and then toppled over on the boards of the stage; but the boa did not in the least relax his grip upon the corpse, which remained for more than an hour imprisoned in its hideous thraldom, nobody daring to approach the lithe monster, of whose powers such appalling proof had been given. At length it occurred to one of Karolyi's attendants to place a bowl of milk in a cage within sight of the mighty serpent, which slowly unwound itself from the dead body and glided into its den, irresistibly tempted thereto by its favorite dainty. A post mortem examination of the unfortunate athlete's remains discovered no fewer than eighty-seven fractures of his bones effected by the constriction of the serpent's coils.

HINTS TO THE YOUNG STEAM FITTER.

BY WILLIAM J. BALDWIN.

The low pressure gravity circulation is at present very much used in the steam heating of private houses, churches, and schools. Its principal merits, when well done, are: It is safe; it is noiseless; the temperature of the heating surface is low and uniform; all the water of condensation is returned into the boiler except a very small loss from the air valves; it is easy to keep the stuffing boxes of the heater valves tight; and it is no more trouble to manage than a hot water apparatus.

There are four systems of low pressure steam piping, whose principal features are:

1st. Main distributing pipes and distributing risers, with corresponding return mains and risers (see Fig. 1, at A).

2d. Main distributing pipes and distributing risers, with a corresponding return main and a separate return riser for every coil or heater, the return risers not to be connected to each other until they are below the water line (see Fig. 1, at B).

3d. Main distributing pipes and distributing risers, with corresponding return mains and no return risers, the distributing riser carrying the water of condensation back through a relief to the main return pipe on the floor of basement (see Fig. 1, at C).

4th. (The single pipe job always a small one.) A single pipe for every heater, run directly from the top of the boiler to the heater, rising all the time in the direction of the heater, and of size sufficiently large that the steam passing to the heater to supply the loss from condensation will not interfere with the condensed water returning along the bottom of the pipe.

NOMENCLATURE.

The same names always apply to the same part of the circulation, no matter what the system. The word circulation means the whole distribution of pipe in any one job.

The Main Steam or Distributing Pipe.—The nearly horizontal live steam main, generally near the cellar ceiling (a' a'' a''').

The Main Return Pipe.—The nearly horizontal pipe on the floor, or thereabouts, of the cellar, for carrying the condensed water back to the boiler, b' b'' b'''.

The Steam Riser.—The pipe that carries the steam from the main distributing pipe to the radiators (c' c'' c''').

The Return Riser.—The pipe that carries the condensed water from the radiators to the main return (d' d'').

The Steam Riser Connection.—The pipe that joins the main distributing pipe and steam riser (e' e'').

The Return Riser Connection.—The pipe that connects the return riser with the main return pipe on the floor, and which has one or more T's in it below the water line to receive the steam riser relief (f f).

The Steam Riser Relief.—The pipe that connects the bottom of the steam riser with a T in the bottom of the return riser connection or main return pipe below the water line, to carry the water that runs down the steam riser into the return riser connection or main return pipe (g g).

Main Relief Pipes.—Connections between the main steam and return pipes, to throw the water carried from the boiler, and what is condensed in the main steam pipe, into the return main, also as an equalizer of pressure in the system (h).

Radiator Connections.—The pipes which run from the risers to the radiators, both steam and return, usually no longer than is necessary to get spring enough for the expansion of the risers (i i i).

A Relay.—The jumping up of a main steam pipe, with a main relief at the lower corner. This is to admit of keeping the main steam pipe near the line of the risers and the ceiling, and above the water line when the main lines are long (j).

Pitch.—Is the inclination given to any pipe, and in the steam mains of a low pressure apparatus should be down and away from the boiler (except in system No. 4), and if possible toward the boiler in the main return. (When the water and steam run in the same direction through pipes one source of noise is prevented.)

Water Line.—The general level of the water in the boiler throughout the apparatus. In some cases, where the boilers are at a distance, or in a sub-cellar, and the fitter wishes to gain the advantages of having returns and reliefs coming together below water, he makes an artificial water line by raising the main return pipes higher than his connections before he drops to the boiler. It is also necessary to bring a relief from the main steam pipe to this raised part of the return to prevent siphoning into the boiler.

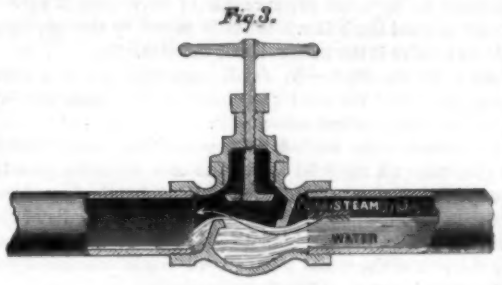
HOW A BUILDING IS PIPED.

The steam-fitter should commence his work in a new building early, and architects and parties paying for the work should see that the contract for steam heating is let when the mason and carpenter work is let.

The risers are the first work done in a new building that proceeds in the ordinary way. If the builder and steam-fitter have an understanding at the commencement of the work, the former can leave the proper recesses in the walls exactly where the steam-fitter wants them. This will save much work to the fitter, and prevent the mutilation of the walls and be no expense to the mason.

Fig.2.

Fig.3.



POSITION OF VALVE.

When the walls are up, the joists in their places, and the roof boards or roof on, the steam-fitter should then put up his risers.

If the building has not more than three floors to be heated it will do to rest the risers on a support at the bottom of the recess, but in higher buildings the risers should be suspended by the middle, so that the expansion may be divided. By allowing the riser to go both up and down from the middle the steam-fitter will be able to get along with shorter radiator connections, and will avoid the deep cutting of the floor joists.

The steam-fitter should avoid as much as possible taking two heaters from the same steam connection on a floor, and if it is unavoidable he should drop his returns down and bring them into the return riser some distance apart; or, better still, he should run them separately down below the water line (system No. 2), as it will prevent one heater from taking the air from the others.

If the risers are on the side of the room so that their outlets look between the joists, it is best to keep the T's about half way between the laths and the flooring, as this admits of nippling up, and leaves room for crossing the pipes, if required, below the floor. But if the outlets come at the side of the joists care must be taken that the T's come in the exact place. In a building with the risers resting on the bottom and all the expansion upward, the top outlet must be the lowest from the top of the joist, but only low enough to come within ¼ of an inch of the floor when expanded to their utmost; so also with the rest of the T's, according to their distance from the bottom of the riser.

With low pressure steam, the steam risers should be large

Fig.1

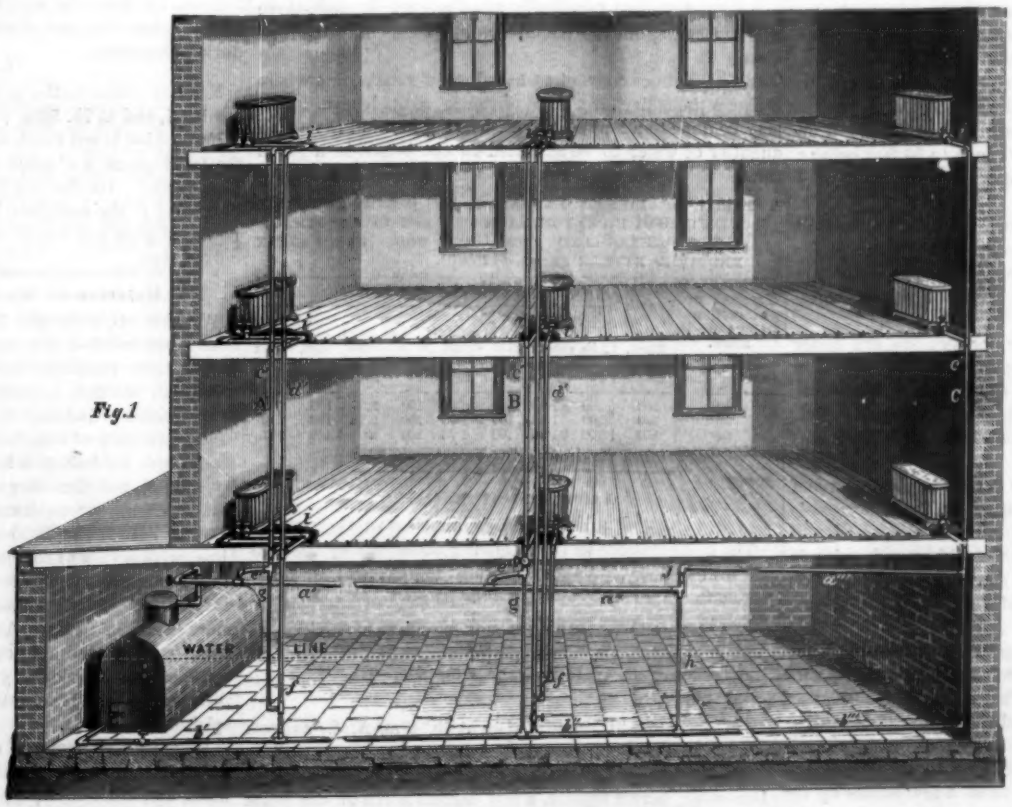


FIG. 1.—SYSTEMS OF PIPING.

The general practice with steam-heaters is to reduce one size of pipe for each floor. This rule is not arbitrary, but as architects' specifications usually call for it there are no objections, provided the pipe is large enough.

In system No. 1 the return riser is generally one size smaller than the steam riser, but it should never be smaller than a ¾ of an inch pipe.

In system No. 2, where many return risers are brought down in the same place, a 1 inch pipe for large heaters and a ¾ pipe for small ones are usual.

When the risers are all in the outlets should be plugged up with pieces of pipe, a foot or so in length, instead of the ordinary plug, as the latter is often difficult to get out when the plastering is done.

The risers should then be tested with cold water to from 100 to 200 pounds per square inch; this will prove if there are any cracked fittings or split pipe, and will save much time and annoyance when steam is gotten up.

The best way to cover a riser recess is with a board. Have grounds put on before the plastering is done, and screw a panel on afterward. Some architects require the recess to be plastered over, using slate or coarse wire cloth to hold the plaster. The latter makes the best work, as the heat from the riser will not crack it.

When automatic air valves are to be used on the steam heaters, a ⅜ inch pipe should be run in the riser recess, with an outlet at each floor to receive the air valve connection. The lower end of this air and vapor pipe should be taken to the nearest sewer outside of the sewer traps.

At this stage of the work, and before the floors are laid, the radiator connections should be run and firmly fastened in their places, making due allowance for the thickness of the furring on the walls, the plastering, and the baseboard. The radiator connections are usually run 1 inch or 1¼ inch for the steam connection, with a corresponding ¾ or 1 inch pipe for the return, according to the size of the heater; one and a quarter inch steam being enough for a radiator of 150 square feet of heating surface at low pressure, with a main of sufficient size.

When the radiator valves are threaded right-handed the elbows on the ends of the connections may be left-handed, to admit of connecting by a right and left hand nipple below the valve and between the valve and elbow, or *vice versa*.

When both valves are at the same end of the radiator, it is better to have the right and left nipples between the valves and the radiator. With this arrangement both valves of the radiator can be connected simultaneously, and the movement of the radiator will be in the direction of the valves. It also admits of the disconnection of a heater, after simply closing the radiator valves.

When the radiators are to be connected by any of the foregoing plans the connections can be firmly fastened, but not confined at their ends, that they may come in their exact places through the floors. The free ends of the connections should be closed with pieces of pipe long enough to come above the floors when laid. The air pipe should also be run at the same time and brought through the floor in close proximity to the position the air valve will occupy on the heater.

At this stage of the work the steam-heater usually waits until the floors are laid, plastering done, partitions set, and the basement graded.

Steam Mains.—Nearly all the success of the apparatus depends on its steam mains, their sizes, and how they are run.

A job has never yet been spoiled by having its steam mains large; still there should be a limit to their size, to prevent unnecessary expense and to keep the condensation and radiation of the distributing pipes at a minimum consistent with the actual requirements of the heating surfaces.

The size of steam mains depends on the pressure of steam to be used, the distance it is to be carried, the temperature of the exposure of the heating surfaces, and their extent. But as it is not my intention here to speak of steam used expansively, I shall endeavor to give sizes only for direct-return or gravity circulation apparatus.

Gravity circulation apparatus are of two kinds, low and high pressure. The low pressure apparatus depends on the difference of level of water in the return risers and the boiler for a circulation, irrespective of the steam pressure at any part of the distributing pipes; but the maximum pressure of steam to be carried must never exceed the equivalent of a difference in level of water between the water line of the boiler and the lowest part of the distributing main.

There is another condition under which this system will

work, and that is an increase of pressure sufficient to nearly establish a pressure throughout the apparatus, the difference in pressure at any part of the apparatus not to exceed the equivalent of a head of water between the water line in boiler and the lower part of the steam main. It is then a high pressure gravity circulation.

A well arranged gravity circulation should be made to work at any pressure, for with its heating surface properly proportioned it can be made to meet the exigencies of fall, winter, or spring weather by simply carrying a pressure suitable to the occasion.

To have the water of condensation return directly into the boiler under all conditions and pressures, the main pipes must be large enough to maintain the pressure of the boiler to within 1 or 1½ pounds in every part of the apparatus, and the water line of the boiler should be not less that 4 feet from the bottom of the horizontal distributing mains, at their lowest part, and that only in short mains, such as the generality of city business buildings and blocks. In large public buildings and others that have their boilers in outhouses, the difference between the boiler line and the mains should be all it is possible to get.

A main should not decrease in size according to the area of its branches, but very much slower, and should be rated by the heating surface and the distance it is to be carried. Neither should the main at the boiler be equal to the aggregate size of all its branches—an expression very much in vogue in specifications for steam heating.

Mains which have given the best results leave the boiler of sufficient size (calculated from practical results), and are reduced very slowly, if at all, until very near the end.

The area of the cross section of a 1 inch steam pipe is taken as unity for the sake of easy calculation in the rating of steam pipes, and the area of a 1 inch pipe in the main, at the boiler, to each 100 square feet of heating surface, mains included, is deduced from the size of the mains and heating surfaces of some of the best heated buildings in the United States, and has been the writer's rule for some years.

When the main steam pipe leaves the boiler it should, if possible, be carried high up at once, and have the stop valve at the highest part in the pipe, so that condensed water cannot lodge at either side of it when shut. This will prevent cracking at this part of the pipes when the valve is opened. If this arrangement cannot be carried out, and the valve has to be nippled on the dome of the boiler, or if there are several boilers and they have to be made interchangeable with regard to their use, there should be a relief of large size in the main, just outside the valves.

It is well to mention here that a relief which leaves the steam pipe must be brought into the return pipe in a position corresponding exactly to where it leaves the main; that is, when it comes from the outside of the main stop valve it should be taken to the outside of the main return valve. Otherwise, if an attempt is made to shut off, and both valves are closed, the water will back up and fill the apparatus. So also with all branch risers or connections; if there is a valve in the steam part, there must also be one in the return, and reliefs must leave the steam pipe and enter the return on corresponding sides of the respective valves.

From the highest point the main steam pipe should drop slowly as it recedes from the boiler (1 inch to 10 feet being a good pitch), that the course of the steam and the water may be in the same direction.

A main steam pipe should not run very close to the wall up which the risers go. There should be room enough for a riser connection 2 or 3 feet, and when the mains are long and the expansion much the distance should be increased.

The T's in the main, for the riser connections, are better turned up than sidewise, as by nippling an elbow to them you can get any desired angle, and should the measurement for the main be a little out it will make no difference. This arrangement also makes a good expansion joint if the mains have much travel.

Where the pipe reduces in size it is well to put in a relief in the lower side of the reducing fitting, as the water that is pocketed there by the large pipe pitching in the direction of the smaller one may be the cause of cracking and noise in the pipe. Some steam-heaters use an eccentric fitting in reducing, which brings the bottom of the pipe on the same line and makes nice work.

When it is necessary to have stop valves to the risers the steam-fitter often places them in the riser connections, with a valve also in the riser relief. This arrangement requires three valves, and also stops the local circulation and equalization of pressure.

It is better to use only two valves, one to the steam and one to the return riser, and place them a few inches up the riser, above the riser connection, which brings them also above the steam riser relief, saving a valve and lessening the chances for noise in the pipes.

In system No. 2, where the returns are carried down separately and collected together below the water line, the return valve should be below all such connections, and the steam riser relief should have a separate connection with the main return and have no valve. Straightway valves are best for risers.

The extreme end of a steam main should be connected by a relief with the main return, being in fact a continuation of the main down and into the return.

Stop valves in main steam pipes are either globe, angle, or straightway. When a globe valve is used it should be turned with its stem nearly horizontal, as shown in Fig. 2. The reason for this is obvious, when we consider that the water of condensation in any pipe runs along the bottom of it. When a globe valve is turned up, as in Fig. 3, the water in the pipe has to half fill it before it flows over the valve seat to pass along in the pipe. Not so when the valve is on its side for then the side of the opening of the valve seat is as low as the bottom of the pipe.

Neither should the stem of any valve be quite down to the horizontal position when it can be avoided. It should be raised enough (10 degrees) to prevent water from collecting in the threads of the nut and stem, and being forced out, by the pressure of the steam, through the stuffing box, making a constant dropping of water, which is almost impossible to hold with ordinary packing. Not so with dry steam; it can be held.

Globe or angle valves should be so turned in a heating apparatus that by simply closing the valve to be packed and its corresponding valve in the return, or *vice versa*, and waiting for the steam to cool down, the stuffing box or gland can be removed without the escape of steam. To do this it is necessary to have the pressure side of every pair of valves turned toward the boiler. What is meant by the pressure side of a valve is the under side of the disk.

Main Return Pipes.—In small apparatus (up to 3 inch steam pipe) they are usually run one or two sizes smaller than the corresponding steam pipe.

In returns, which are below the water line, or are trapped to give them an artificial water line and are consequently always full of water, there are no currents but the flow of the water toward the boiler. This style of return admits of the smallest piping, but good practice has placed it at one quarter the area of the steam pipe, for all conditions, for apparatus with larger than 3 inch steam pipe.

In dry returns—*i. e.*, which have no water line—there are local currents, often going in contrary directions, the water gravitating toward the boiler, the steam flowing to the heaters, and the air, the greatest source of annoyance to the steam-heater, going every place and any place except out of the air valve. This style of return is not much used, but in cases where there is no basement it cannot always be avoided.

One half the area of the steam pipe has been found in practice to give good results in dry return pipes.

Check valves are generally used in return pipes where they enter the boiler. Some steam-heaters leave them out on account of the back pressure they cause to the return water, but the practice is very much to be condemned when two or more boilers are connected, as an inequality in draught or the cleaning of a fire will make a small difference of pressure between boilers, causing the water to run from one boiler to another through the return pipes.

Check valves of large area in the opening, with a small bearing on the seat, can be made that will not give more than a quarter of a pound back pressure. If the valve is not ground and cleaned frequently when the job is new, there will be nothing but the actual weight of the disk to overcome.

It is sometimes convenient to reduce a return pipe where it enters the boiler for a short distance of its length. This may be done to a limited extent, bearing in mind the actual quantity of water to be admitted to the boiler in a given time.

A TABLE OF LINEAR EXPANSION OF STEAM PIPES (TO WITHIN 0·01 INCH) FOR EACH 100 FEET IN LENGTH, AT TEMPERATURES AND PRESSURES MOST FREQUENTLY REQUIRED BY THE STEAM-FITTER.

Temperature of weather when pipe is fitted.	Length of pipe when fitted.	Length of pipe when heated to							
		215° or 1 lb. steam.		269° or 25 lb. steam.		301° or 50 lb. steam		343° or 100 lb. steam	
Degrees Fah.	Feet.	Ft.	Ins.	Ft.	Ins.	Ft.	Ins.	Ft.	Ins.
0	100	100	1·80	100	2·26	100	2.53	100	2·88
32°	100	100	1·54	100	1·98	100	2·26	100	2·61
64°	100	100	1·20	100	1·73	100	2·	100	2·35

Astronomical Notes.

OBSERVATORY OF VASSAR COLLEGE.

The computations in the following notes are by students of Vassar College. Although merely approximate, they will enable the observer to recognize the planets. M. M.

POSITIONS OF PLANETS FOR DECEMBER, 1879.

Mercury.

On December 1 Mercury rises at 8h. 37m. A.M., and sets at 5h. 26m. P.M.

On December 31 Mercury rises at 5h. 47m. A.M., and sets at 3h. 6m. P.M.

Mercury should be looked for during the last week of December, before sunrise, a few degrees north of the point of sunrise.

Venus.

Although less brilliant than in November, Venus will be very beautiful in the early morning through December.

On the 1st Venus rises at 3h. 9m. A.M., and on the 31st at 3h. 54m. A.M.

It will be at its greatest western elongation on the 3d. On the 10th of December Venus and the narrow crescent of the waning moon will rise nearly at the same time, Venus being north of the moon. A telescope of three inches aperture will show that the disk of Venus, like that of the moon, is seen only partially enlightened by the sun. It will be half illuminated in December.

Mars.

Mars was in its best position in November, but it will be more likely to be observed in December, as it comes to the meridian during the evening and precedes the beautiful group of the Pleiades.

On December 1 Mars rises at 3h. P.M., and sets at 5h. 8m. the next morning.

On December 31 Mars rises at 59m. after noon, and sets at 3h. 13m. the next morning.

A small telescope will show peculiar markings upon Mars; it is, however, less interesting then Jupiter and Saturn, as its newly discovered moons can be seen only by means of the largest telescopes.

On the evening of December 23 the moon will be seen to draw near to Mars, and after midnight to pass east of the planet, Mars being about 3° lower than the moon in altitude.

Jupiter.

Jupiter is still the great light among the planets, yet is setting earlier, and is perceptibly more remote from us.

On December 1 Jupiter rises at 26m. after noon, and sets at 11h. 7m. P.M.

On December 31 Jupiter rises at 10h. 38m. A.M., and sets at 9h. 31m. P.M.

If we take the hours from 8 to 10 P.M. for observing Jupiter we shall not see the first satellite during a part of that period on the 5th, 14th, and 21st, because it is behind the planet; it is unseen because in transit across the planet, December 6 and December 13; on the 30th it reappears from the shadow, having been eclipsed.

The second satellite, the smallest, is not to be found at some part of the period from 8 P.M. to 10 P.M., because behind the planet December 1, and in transit across the planet December 10 and 17.

The third satellite reappears from transit December 9, and disappears December 27, by passing into the shadow of Jupiter.

The fourth satellite will not be seen on the evening of December 31, because in Jupiter's shadow. The moon will pass east of Jupiter on the evening of December 18.

Saturn.

With a powerful glass Saturn is even more interesting than Jupiter; with an ordinary glass its ring and the two larger satellites can be seen.

On December 1 Saturn rises at 1h. 51m. P.M., and sets at about the same hour the next morning.

On December 31 Saturn rises at 11h. 53m. A.M., and sets 3m. after midnight.

Between December 18 and December 24 the moon passes Jupiter, Saturn, and Mars by its motion in orbit; it passes Saturn before noon of the 21st. On the evening of the 20th Saturn will be east of the moon; on the evening of the 21st Saturn will be west of the moon.

Uranus.

On December 1 Uranus rises at 11h. 27m. P.M., and on the 31st at 9h. 29m. P.M.

Uranus is near the star Lambda Leonis, 2¼° nearer the horizon when that star culminates, or between 4 and 5 A.M. during December.

Neptune.

Neptune comes to the meridian at 9h. 50m. P.M. of December 1, and at 7h. 50m. December 31.

Its position is not much different from that of Mars. On the 1st Neptune is 4° south of Mars, and passes the meridian 14m. earlier. On the 31st Neptune is 15m. earlier than Mars in coming to the meridian, and 5° south of Mars. Only a powerful glass will enable the observer to distinguish it from a fixed star.

Relation of Masters and Apprentices.

We have often thought that if masters properly comprehended the relation they sustain to their apprentices and employes, their pecuniary interest would not only be greatly enhanced, but that a positive good would be rendered to every branch of industry in which they are engaged.

The first duty of a master should be to present in himself an example for imitation in the elements of industry, morality, system, and the other attributes which constitute a superior mechanic or workman. They should, moreover, observe and study the dispositions and minds of their apprentices, with a view of conciliating their regard and confidence, and through this means to establish a free and familiar intercourse, and render the task of instruction and development more simple and easy. As the apprentice advances in knowledge and skill, suitable evidences of appreciation and encouragement should be given them. This will stimulate their ambition and exertion, and create among them a worthy spirit of emulation.

Where the character of an apprentice is such as to require a tight rein upon his actions, and the deprivation of privileges, and other suitable punishments for idleness and misconduct, care should be observed that these curbs and punishments do not descend into such acts of tyranny as will destroy the spirit and ambition of the youth, and render him obstinate, unruly, and beyond all future influences of excellence and good. Besides a thorough instruction in his trade or profession, and a sound and healthy education to otherwise render him fit for his social position in life, it should be the aim of a master to instill into his pupil all the scientific and other knowledge possible, even should such knowledge have no direct bearing upon the business or trade in which he is engaged. Such acts of interest, kindness, and confidence as these, and others of a corresponding character, cannot fail to produce the most marked beneficial results upon the interests of the master, and the happiness and future of the grateful apprentice.

AMERICAN INDUSTRIES.—No. 25.

THE MANUFACTURE OF SPOOL COTTON.

The manufacture of spool cotton requires machinery and processes so elaborate and so expensive, that the industry cannot be profitably conducted except on a very large scale. For this reason the making of the spool cotton used in this country is mainly confined to a few large factories, and we are informed that there is but a single company in America that makes all numbers of six-cord sewing cotton from the raw material. This is the Willimantic Linen Company, whose works we illustrate.

The company began business in the manufacture of linen; being deprived of flax by the breaking out of the Crimean war, they turned their attention exclusively to cotton thread, but the original style of the firm was retained.

The business offices of this company are located at Hartford, Conn.; the works are at Willimantic, on the river of the same name, about 125 miles from New York and 90 miles from Boston, on the New York and Boston Air Line Railroad. Two other railroads—the Hartford and Providence and the New London Northern—pass through the place, and hundreds of their passengers every day catch sight of the great, gray, six story mills of the thread company, built up of granite quarried out of the very ground on which they stand; and see, too, the rows of neat and comfortable tenements ranged along the streets. There are four large mills, picturesquely set upon the east bank of the river, and stretching, with their surrounding grounds, over a space of three quarters of a mile. The buildings and grounds are noticeably clean and orderly in appearance. By a series of dams, aided by a sharp natural fall, a force of fifteen hundred horse power is secured from the river for the factories. In these mills, as we learn from the elaborate description of them in *Scribner's Monthly*, to which we owe much of the information here given, more than a thousand workpeople—women and men, and girls and boys—are kept constantly busy at the various labors that combine to make thread.

The first operation in the preparation of the raw material for spinning is to run it through a machine called a "picker," which cleans about a thousand pounds a day.

The picker picks or beats out the dirt and seeds, and the cleaned cotton rolls out of the machine in laps, which are carried to the carding room, shown in one of the lower views in the engraving on the first page. The carding machine arranges the cleaned fibers parallel to each other, and delivers the cotton in a thin, narrow ribbon. After this operation the strand is run between sets of rollers, one set revolving faster than the other. This is called "drawing," and it is one of the most important parts of thread making. If one set of rollers, for instance, turns ten times as fast as the other, the strand that passes out between them is, of course, ten times lengthened and ten times as fine as the original. This is a "draught of ten," as it is called. The drawing may be in any ratio, and any number of strands may be run together into one at the same time that that is drawn. Five strands, for example, drawn with a draught of ten, would make a new strand half the size and ten times as long. This process of uniting strands is called doubling, and the doubling, running together, drawing down, and reuniting and redrawing are carefully watched, so that the size of the strand and the amount of work on it may be at any time known. The operation is repeated again and again; but all this doubling is not done without interruption. After the first few drawings, the long white ribbons of cotton which, in this condition, are called "slivers," are passed through another machine, which combs them again to remove all foreign substances; it also takes out all of the short fibers, leaving only the longer fibers to be worked into thread. The short fibers which are removed are sold for other manufactures. After combing, the sliver is doubled and again reduced in size, and then twisted for the first time in the roving frames and wound upon large spools, and it is afterward drawn and twisted in two separate machines before it is carried to the spinning mules.

The room in which the spinning is done is represented in the larger view in the engraving. In each of these machines there are several hundred spindles, which revolve very slowly as they are carried forward by the carriage in winding the thread on the spindle, but revolve with great speed as the carriage draws back in the operation of spinning. The spinning mule is entirely automatic in its action. The marvel of it all is the mathematical precision with which it begins, stops, and reverses, and the care with which it suitably varies its work each time to the needs of its case. The mule is all the while attended by a barefooted and lightly-dressed man or boy, whose business it is to unite such strands as accidentally part. On these mules the yarn is made of any size that is required. It is at Willimantic spun down to a fineness that rivals even the spider's web.

From the spinning mules the cops go to the cop winders, where two strands are wound together on a single spool. These two strands are twisted in a machine in which the bobbins revolve at a speed of about 5,000 revolutions per minute, and the thread is wound on the bobbins by a simple differential arrangement, which accommodates itself to the increasing diameter of the bobbin. Three of these double strands are twisted together, forming the well-known six cord spool cotton.

The spools from the twisting machines are conveyed to reeling machines, which form hanks suitable for bleaching, dyeing, etc.

During every step in the progress of the cotton, from the raw state to the finished thread, it is repeatedly examined by experts, and if at any stage it is not in all respects up to the standard it is rejected and never finished. Delicate instruments, which are used in testing the thread, are to be seen in all departments of this immense establishment. It is only by continually and closely watching the various steps in the manufacture of thread, that a uniformity in quality is secured.

It is established by all spinners that 7,000 grains shall be a pound in cotton, and that yarn of which 840 yards weigh this pound, shall be number "1." Every now and then, therefore, all through the mill, a very accurately gauged reel, or some similar instrument, is used to measure off an even fraction of 840 yards. The measurer may be careless in taking off his sample, but that makes no matter. At exactly the right point the reel breaks the strand and calls attention to the fact by ringing its signal bell. Then this sample, say 120 yards or one seventh of "a hank," is weighed on scales also gauged to show the most delicate variations. If the yarn or roving is number one, and weighs one-seventh of 7,000 grains, it is exactly correct; if 120 yards of No. "30," for instance, were being sampled, it should weigh one-thirtieth of one seventh of 7,000 grains. Every time a variation appears, the cotton is made to thicken up or thin out as is needed. This testing is done repeatedly, and the results are recorded in books kept for the purpose, so that the course of any of the cotton on its three weeks' cruise of three thousand miles through the factory, can always be traced and faults found and corrected at once. Nothing more impresses one with the wonderful accuracy of the process than to watch one of these testings, note the exact measurement of the sample, and rigidly careful weighing, and see the gravity with which the overseer marks down the pettiest variations to the 28,000th of a pound! It all tells upon the thread, and making it correct through all its processes guarantees it correct, of course, when finished.

After the thread is made the work on it is by no means finished. To prepare it for market it must be inspected, washed, bleached, dried, perhaps dyed, spooled, and boxed, and the spools and boxes are also made in the factory.

After the operations already described the hanks of thread are placed upon reels and transferred to large spools in the department represented in one of the upper views. The thread is then conveyed to the winding machines which take the spools, and, holding them between centers, revolve them, start the thread, wind it back and forth with the utmost precision, making allowance for the beveled ends, stop when the required 200 yards are wound, nick the spool, put in the thread, cut it off, and release the spool, all without attention. All that is required of the attendant is to see that thread is supplied, and to keep the hoppers full of spools.

One of the most interesting machines in this establishment is the machine for ticketing the spools. One girl supplies it with sheets of printed labels, and another feeds it with spools; it does the rest automatically. Provided with the labels, it cuts out, pastes, and fastens the proper mark for each end of the spool, and prepares a hundred spools a minute. The machine does the work of many girls, and it never tires.

The winding machine, the ticketing machine, and the automatic spool-making machine—inventions belonging to the Willimantic Company—are so essential to the thread business that the privilege of using them is rented by other manufacturers.

Everybody knows the sizes of thread. Every seamstress knows whether she wants No. 30 or 60 or 120, and knows, when she hears the number, about what is the size of the strand alluded to; but how the numbers happen to be what they are, and just what they mean, not one person in a thousand knows. It is a simple matter to explain. The standard of measurement is the same already recited. When 840 yards of yarn weigh 7,000 grains (a cotton pound), the yarn is No. 1; if 1,680 yards weigh a pound it will be No. 2 yarn. For No. 50 yarn it would take 50x840 yards to weigh a pound. This is the whole of the yarn measurement. Thread measurement rests on it. The early thread was three-cord, and the thread took its number from the number of the yarn it was made of. No. 60 yarn made No. 60 thread, though in point of fact the actual caliber of No. 60 thread would equal No. 20 yarn, being three 60 strands. When the sewing machine came into market as the great consumer, unreasoning in its work and inexorable in its demands for mechanical accuracy, six-cord cotton had to be made, as a smoother, rounder product. As thread numbers were already established, they were not altered for the new article, and No. 60 six-cord and No. 60 three-cord are identical in size as well as number. To effect this, the six-cord has to be made of a yarn twice as fine as the three-cord demands. The No. 60 six-cord would be six strands of No. 120 yarn. To summarize: yarn gets its number from the arbitrary formula that 840 yards weigh 7,000 grains. Three-cord spool cotton is the same number as the yarn it is made of. Six-cord spool cotton is made of yarn that is double its number.

As simple a thing as thread seems to be, the Willimantic Company makes 1,200 different kinds, and it takes 10,000 dozen spools to hold each day's product.

THE St. Gothard tunnel makes steady progress, no less than 3,000 workmen being engaged upon it. Nearly 10 tons of dynamite are used per month.

MISCELLANEOUS INVENTIONS.

Mr. A. Edward Barthel, of Detroit, Mich., has invented a hammerless self-cocking and rebounding firearm, the improvements being applicable to shotguns, rifles, or revolvers, either single-loaders or magazine arms.

Mr. Zebina M. Hibbard, of Brooklyn, N. Y., has patented a trace fastener provided with a screw stem that works in the threads of the ferrule, and is provided with a shoulder that fits within a rabbet of the ferrule.

Mr. Simeon Garratt, of Columbus, O., has patented a self-acting car coupling, which will couple high or low, which, when running, will only come apart by the use of the lever, but which will immediately separate should the cars run off the track.

An improved adjustable harness pad has been patented by Jacob Johnson, of Ashland, Neb. The object of this invention is to provide a harness pad which may be adjusted to the back of a horse of any shape or size.

An improved bale tie, patented by Mr. William H. Roane, of Pine Bluff, Ark., consists of a rectangular plate, having opposite edges bent over toward the outside, forming flanges or lips, through one of which is made a transverse rectangular slot in line with the outside of the plate, while the other is provided with a similar slot, and with an opening through from the edge of the lip or flange.

An improved spark arrester, patented by Messrs. Silas Byram, of Middletown, Ind., and William R. Hansford, of Hicksville, O., consists of two pipes set one within the other, with an annular space between them, the inner pipe being constructed in vertical sections, with lower edges inclined or drawn inward that are held apart by lugs or straps extending from one to the other, while fixed in the longitudinal axis of each section is a conical deflector, and encircling each section is an annular flange whose diameter is the same as the internal diameter of the outer pipe.

An improvement in candlesticks, patented by Mr. Andrew J. Smith, of Ukiah City, Cal., consists in providing a slitted match box rising up in the candle holder from the bottom of base.

Mr. John Henry Hettinger, of Bridgeton, N. J., has invented an improved can cover, which is simple, readily adjustable, and efficient, and may be used for cans and jars, paint cases, etc. It may also be applied to barrels, boxes, or cases of wood, as well as of metal, by only changing the material of which it is constructed.

An improvement in electric speaking telephones has been patented by Mr. Frank P. Mills, of Ishpeming, Mich. The object of this invention is to increase the sensitiveness of speaking telephones and the resulting effects by a new arrangement of the permanent magnet and the armatures thereof; and it consists, essentially, of a circular or cylindrical magnet surrounding the helix, the poles of which are brought close together, but insulated from each other by a peculiar arrangement and construction of armatures.

Mr. Oscar Kleinberger, of New York City, has patented a suspender having its ends formed of braid or cords which cross and overlap each other two or more times, and are fastened together at their junctions by threads or cords, thus forming a series of button holes or loops of like size.

Mr. Charles P. Blatt, of Elizabeth, N. J., has patented a simple and effective device for keeping beer and other liquids when "on tap" cold and supplied with common air or carbonic acid. It consists of a box or cabinet containing an air-tight chamber, an ice chamber, and a place for the barrel or other vessel containing the liquid.

Messrs. Hartwell A. Crosby and George F. Thompson, Jr. (administrator of Michael W. Thompson, deceased), of St. John, N. B., have patented an improved sash stop and lock. The object of this invention is to provide a more simple and durable sash stop and lock than those now in use. To close a window provided with this device, one has only to reach up and pull down on the thumb piece. If the window is partly open and it is desirable to raise it higher, it is only necessary to push it up, and the pawl will hold it at any point.

An improvement in riding plows, patented by Mr. Alfred Belchambers, of Ripley, Ohio, consists in a riding attachment composed of a frame mounted on wheels and drawn behind the mouldboard.

Commercial Enterprise.

Our English contemporaries seem to be awakening from their lethargy and to realize the cause for the depression in trade among their manufacturers.

Acute observers of the "spirit of the age," says one of the foremost trade journals of England, must have noticed the inborn love of conservatism, and the desire to follow in the footsteps of our fathers or predecessors that distinguishes us from our Continental neighbors and our American cousins. Progression in this country is usually the result of competition, or the force of circumstances, frequently impelling our ironmasters and our colliery owners to move with the times, and the steady-going British manufacturer to remodel his plant, improve his patterns, print his catalogues, and advertise his productions.

There can be no question that in many departments of trade the English name was at one time pre-eminently conspicuous, and our foreign rivals had to be content to follow the lead we were setting them. But, in too many cases now, the position is reversed, and "Jack is as good as his master."

It is unfortunate that such should be so, but a great deal of the present depression in trade is to be attributed to the

apathy of British traders. After being over-credulous for years they are now becoming over-cautious, and improvements or investments which show a good chance of being remunerative are either neglected altogether or postponed to an indefinite period.

The Wagon Hardware Trade.

Pittsburg seems to be a "head center" for the trade in wagon hardware. A recent article in these columns gave our readers an idea of the extent of the wagon and carriage building trade in the United States. A Pittsburg firm, Messrs. Lewis, Oliver & Phillips, employ about 700 men upon wrought iron wagon fittings. They control nearly 100 patents, covering the devices used and the processes for turning out the different parts by machinery. The firm make the necessary fittings for 90,000 wagons per annum, supplying the following wagon-making concerns: Studebaker, of South Bend, Ind.; Milburn, of Toledo, O.; Schuettler, of Chicago; Baine, of Kenosha, Wis., Austin, Tomlinson & Webster Co., of Jackson, Mich., Moline Wagon Co., Moline, Ill., Kansas Manufacturing Co., of Leavenworth, Kansas, and others.

ARTIFICIAL HAYMAKING.

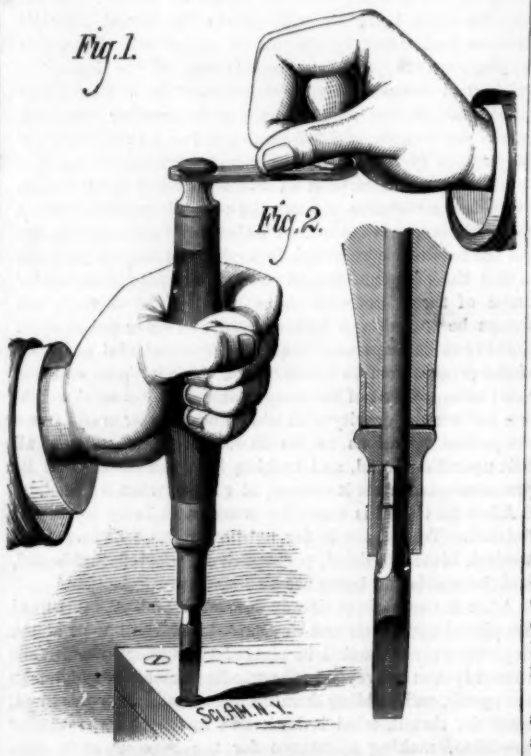
On these islands, says the London *Graphic*, where farmers suffer far more often from excess of moisture than from excess of sunshine, and where crops, which up to the last moment have promised well, are often seriously injured by wet during the process of gathering in, a successful method of artificial drying without the aid of the sun's rays would be an immense boon. For many years Mr. W. A. Gibbs, of Gillwell Park, Chingford, Essex, a gentleman engaged in mercantile pursuits in the city, and also, we may venture to observe, favorably known among the poets of the day, has also devoted much attention to this hay-saving problem. By slow degrees he invented a really practicable process, which is thus described:

"Streams of hot air from the mouth of a hot blast fan, connected with a portable engine, are directed upon masses of wet hay or grain laid in open troughs, and brought in turn, by occasional lifting of forks, under the direct action of the air. By increasing the temperature of the blast it was found that the drying process could be proportionately expedited. Eventually the scheme was perfected by bringing the hot blast fan to bear upon a shed divided into two compartments by an iron partition, and having a space between the iron floor and the ground. Hot air, supplied from the hot-blast fan by means of a duct from an underground furnace, communicates with thirty-two conical perforated tubes on the floor, on which are spiked the wet corn sheaves. These tubes of course are used only for grain. The crowning success of the whole process is an atmospheric hoist, worked by the same engine as the hot blast, which elevates and sends up to the top of a stack, 22 feet high, as many as 960 sheaves per hour."

This year, owing to the unprecedented wet summer, Mr. Gibbs' invention has come to the front and been recognized by practical men as one of extreme value. He says, in a letter to the *Field*: "On Tuesday in last week I lent one of my hay driers to Mr. Ashcombe, of Sewardstone, a practical farmer of long experience and large 'holding.' He started it at 9 A.M., and in ten hours had dried and stacked the produce of ten acres, estimated at one and a half loads per acre. The total cost was £5 10s. for the ten acres, rather less than it would have cost to make the hay in the field, had that been possible. The hay was made from unripe, rank, weedy grass which had been perpetually rained upon; Mr. Ashcombe and his men were inexperienced in the use of the machine, and had no help from me; the hay drier was wholly uncovered, and heavy showers fell on the hay while it was being dried" Yet, in spite of these unfavorable conditions, the result was a complete success. Already several leading agriculturists, among whom is the Duke of Sutherland, have purchased these machines. The price of the large size is £350, but cheaper forms for small holdings, ranging from £50 to £90, are in use, and have done good service.

AN IMPROVED SCREW DRIVER.

The engraving given herewith represents an improved screw driver recently patented by Mr. George Abrams, of Philadelphia, Pa. It consists of a handle through which extends a shaft, having on the upper end a crank and upon the lower end a socket for receiving the screw driver bit.



ABRAMS' CRANK SCREW DRIVER.

With this tool screws may be inserted and removed with much greater facility than with the ordinary form of screw driver, as the motion is a continuous rotary one instead of intermittent.

If desired the screw driver bit may be removed and a drill or boring tool inserted in its place.

MECHANICAL INVENTIONS.

Messrs. Jacob W. Cagle and Joshua W. Nichols, of Greenville, S. C., have patented an improved press for baling cotton, hay, straw, rags, bagging, hemp, etc. It is simple in construction, convenient, rapid, and powerful in operation. It consists of certain novel features which cannot be fully described without an engraving.

An improvement in skiving machines has been patented by Mr. Charles E. Langmaid, of Stoneham, Mass. It consists in a vibrating knife that is hung upon the bed and used in connection with the usual clamps or rolls for feeding the material, and operated by mechanism, whereby the cutting is done with greater facility than heretofore, and the machine may be used for the finest work.

Mr. William H. Silsby, of Chico, Cal., has patented an improved grain separator of that class in which the grain is thrashed and immediately separated from the straw by endless belts. It consists in a peculiar arrangement of parts which cannot be readily described without an engraving.

Mr. John M. Whitney, of Mount Pulaski, Ill., has invented an improved windmill and pump for use in supplying water for stock and other purposes. It is so constructed that the wind wheel may be in operation so long as the wind blows with sufficient force, while the pump will operate intermittently, or only at such times as the tank or trough is empty, or nearly so.

Mr. William F. Rundell, of Genoa, N. Y., has patented an improvement in mowers, which consists, first, in the construction and arrangement of a clutch for connecting the main shaft with the driving gear; second, in the peculiar arrangement of the gauge wheel for the inner end of the cutter bar with respect to the cutter bar and carrying frame; third, in the peculiar form of joint connecting the outer end of the pitman to the cutter bar; and fourth, in the peculiar construction and arrangement of the draught attachment.

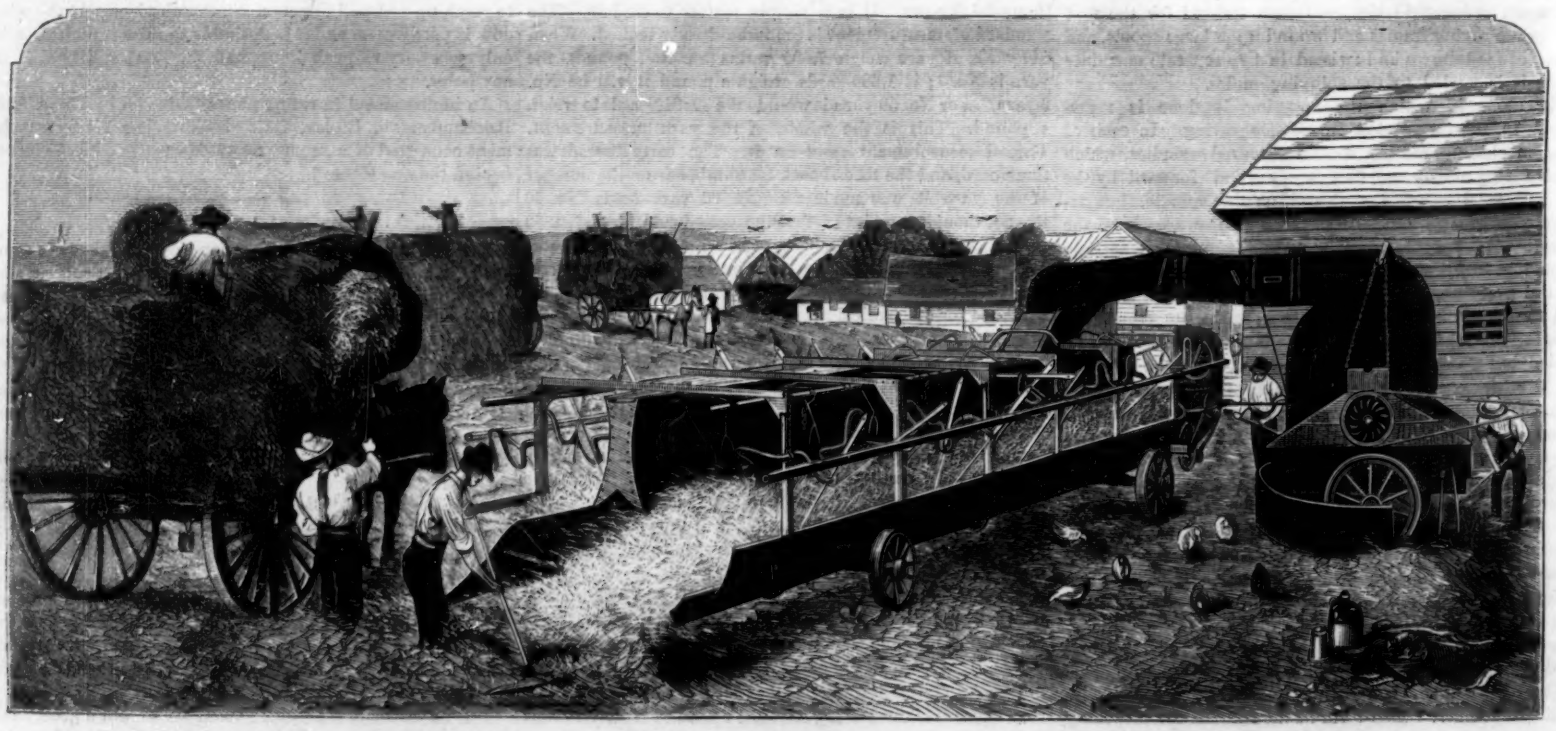
The New Cunard Steamer.

Mr. John Burns, one of the proprietors of the Cunard Steamship Company, writes to the London *Times*:

"It may interest the public to know that my partners and I have just concluded a contract with Messrs. James and George Thomson by which that firm is to build on the Clyde, for our fleet, a screw steamship the size of which will be exceeded only by that of the Great Eastern, while the speed will be greater than that of any ocean steamer afloat. This new vessel will be of 7,500 tons and 10,000 horse power, her dimensions being 500 feet in length, 50 feet in breadth and 41 feet in depth, propelled by inverted direct acting compound engines, with three cylinders and seven oval tubular boilers, having thirty-eight furnaces and 1,000 feet of effective fire grate surface. She will have an extra promenade deck, and will practically be a five decker, being fitted for 450 first class and 600 steerage passengers, with accommodation for a crew of 200 officers and men. Her cargo capacity will be equal to 6,500 tons, with 1,700 tons of coal and 1,000 tons of water ballast, having a double bottom on what is called the 'longitudinal and bracket system.'

"This vessel has been designed, after lengthened consideration, to meet the requirements of our traditional service, and we have adopted in every detail of the ship and engines the most advanced scientific improvements compatible with the safe working of so great a vessel. Among the important matters into which we have crucially inquired has been that of the employment of steel instead of iron, and after a practical and thorough examination into the merits of both materials we have adopted steel for the hull and boilers, but under a provision so stringent that every plate, before acceptance, will undergo a severe and rigid test by a qualified surveyor appointed and stationed at the steel manufactory for that special purpose and that the manipulation of the steel by the builders shall be subject to an equally careful supervision by qualified engineers of our own appointment. The steel is to be made on the Siemens-Martin process, and all rivets as well as plates throughout the ship are to be of steel. The name of the new vessel is to be the Sahara, and she is to be ready for sea in March, 1881."

THE prize of $100 offered by Stillman B. Allen, of Boston, to the boy of York county, Maine, who should raise the greatest amount of corn on one-eighth of an acre this year has been awarded to Joseph Milliken, Jr., of Biddeford, who raised 1,404 pounds



CURING HAY IN WET WEATHER BY AID OF ARTIFICIAL HEAT.

THE IBEX.

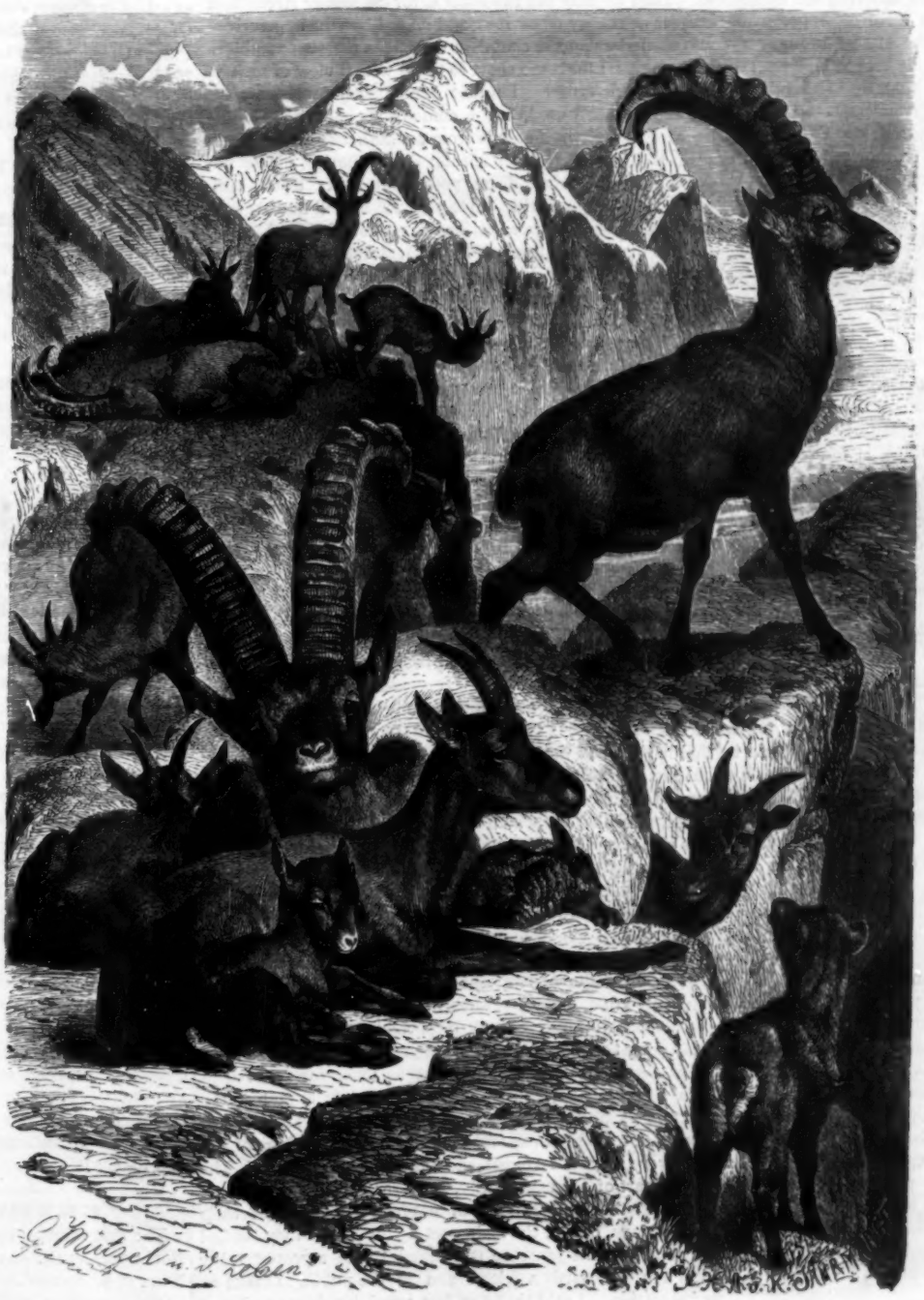
Of the genus *Capra*, which includes several species, the ibex or steinbok is a familiar and excellent example.*

This animal, an inhabitant of the Alps, is remarkable for the exceeding development of the horns, which are sometimes more than three feet in length, and of such extraordinary dimensions that they appear to a casual observer to be peculiarly unsuitable for an animal which traverses the craggy regions of Alpine precipices. Some writers say that these enormous horns are employed by their owners as "buffers," by which the force of a fall may be broken, and that the animal, when leaping from a great height, will alight on its horns, and by their elastic strength be guarded from the severity of a shock that would instantly kill any animal not so defended. This statement, however, is but little credited.

To hunt the ibex successfully is as hard a matter as hunting the chamois, for the ibex is to the full as wary and active an animal, and is sometimes apt to turn the tables on its pursuer, and assume an offensive deportment. Should the hunter approach too near the ibex, the animal will, as if suddenly urged by the reckless courage of despair, dash boldly forward at its foe, and strike him from the precipitous rock over which he is forced to pass. The difficulty of the chase is further increased by the fact that the ibex is a remarkably endurant animal, and is capable of abstaining from food or water for a considerable time.

It lives in little bands of five or ten in number, each troop being under the command of an old male, and preserving admirable order among themselves. Their sentinel is ever on the watch, and at the slightest suspicious sound, scent, or object the warning whistle is blown, and the whole troop make instantly for the highest attainable point. Their instinct always leads them upward, an inborn "excelsior" being woven into their very natures, and as soon as they perceive danger, they invariably begin to mount toward the line of perpetual snow, The young of this animal are produced in April, and in a few hours after their birth they are strong enough to follow their parent.

The color of the ibex is a reddish brown in summer, and gray-brown in winter; a dark stripe passes along the spine and over the face, and the abdomen and interior faces of the limbs are washed with whitish-gray. The horns are covered from base to point with strongly marked transverse ridges, the number of which is variable, and is thought by some persons to denote the age of the animal. In the female the horns are not nearly so large nor so heavily ridged as in the male. The ibex is also known under the name of bouquetin.



THE IBEX.

Preservative of the Dead.

The United States Consul-General at Berlin, Mr. Kreismann, has communicated to the Department of State a new process patented in Germany for preservation of the dead. The liquid used is prepared as follows: In 3,000 grammes of boiling water are dissolved 100 grammes of alum, 25 grammes of cooking salt, 12 grammes of saltpeter, 60 grammes of potash, and 10 grammes of arsenic acid. When cool it is filtered. To 10 liters of this liquid 4 liters of glycerine and 1 liter of methylic alcohol are added. The process of embalming is by saturating and impregnating the bodies with it. From 1½ to 5 liters of the liquid are used for a body.

Volcanic Products at the Bottom of the Pacific.

The Abbé Renard and Mr. J. Murray communicated to the Geological Section of the British Association, at Sheffield, the results of an examination of the materials brought up by the Challenger's instruments from the bottom of the central Pacific. The area from which the materials submitted to the Abbé Renard were derived extends from the Sandwich Islands to 30° S. lat., having the Low Archipelago approximately in its center. Volcanic matter was found to play an important part in the formation of the bottom, being present in the form of lapilli and ashes distributed in great abundance in the "red clay," of which we have heard so much. The lapilli nearly all belong to the basaltic type, passing from felspathic basalt to allied rocks, in which the vitreous base acquires greater and greater development, until it almost entirely displaces the crystalline constituents of the basalt, when the fragments become mere glassy rocks of the basic series, generally containing some crystals of peridote, innumerable crystallites, the latter sometimes grouped in opaque granules, sometimes arranged regularly around the peridote microlites. From the forms of these volcanic fragments, which are often coated with manganese, their association with volcanic ash, and their lithological constitution, they cannot be derived from submarine flows of lava. They are rather incoherent volcanic products, or lapilli, the accumulations of which in the Pacific form a series of submarine tuffs.

One of the most remarkable facts, brought to light by these soundings in the Pacific, is the large share taken in the formation of these sedimentary deposits by palagonites, perfectly identical in lithological characters with those of Sicily, Iceland, and the Galapagos islands. Many are in fact glasses of the basic series, either consisting of sideromelane, or decomposed into a red resinoid substance. The small lapilli of two or three inches in diameter are cemented by zeolites, showing the crystalline forms of christianite. The presence of these readily alterable basic glasses at once reveals the source of the clayey matter with which they are associated, as wherever rocks of this type occur their decomposition into clay is observable.

Among the minerals present in the volcanic ash are rhombic tabular crystals of plagioclase, augite, magnetite, and a little sanidine or hornblende. It is singular that quartz grains are practically absent, in striking contrast to coast deposits. This fact, however, is not so unexpected as the formation of zeolites in the free state. Minute fibrous radiated spherules are formed in the mud, possessing the crystallographic characters of christianite.

Besides these zeolitic spherules, other crystals of the same kind occur in the form of minute prisms, and in such prodigious numbers that they make up about one third of the red clay. These and the zeolitic spherules are regarded by the authors as belonging to one mineral species, and they remark that the formation of these and of the red clay in which they are developed is easily understood if we bear in mind the lithological nature of the basic tuffs and of their products of decomposition.—*Nature.*

NATURAL HISTORY NOTES.

THE BEHEADING OF FLIES BY A WESTERN PLANT.—In the *Bulletin de la Société Botanique de France* (vol. xxiv.), says Professor Asa Gray, there is an account by M. J. Poisson of his observations upon *Mentzelia ornata* as cultivated in the Jardin des Plantes, Paris, and the very singular mode in which it causes the destruction of flies. It is so curious that the essential points of M. Poisson's communication are here recapitulated, in the hope that observations may be made in this country, either by the few who are able to cultivate this ornamental plant with success, or by those who can examine it in its native stations. It is well known that the roughness of this and some related *Loasaceæ* is owing to the stiff bristles of the surface being provided with an armature, at certain points along their length, of retrorse barbs. There are three or four whorls of these barbs, and four or five barbs to each whorl, on the larger bristles; in the smaller there is only a terminal whorl of barbs, in the manner of a glochidiate bristle. Mixed with these harpoon-like bristles are some soft ones, tipped with a capitate gland, which secrete a viscid matter attractive to insects. It appears that flies so attracted thrust in their proboscis between the thickly-set glochidiate bristles to feed upon the secretion of the glands between and below. The retrorse barbs interpose no obstacle to this; but when the proboscis is withdrawn, its dilated and cushion-like tip catches in the barbs, and holds all fast. The harder the backward pull, the firmer and more extensive the attachment to the sharp barbs. The wounded and impaled organ becomes congested and swollen, and the insect is seldom able to disengage it. Especially is this the case with the larger flies. Some perish by exhaustion; but more of them, passing round and round in a circle, and in one and the same direction, come to an end by twisting off their heads. Insects too small to be impaled on the barbs are held fast by the viscid secretions of the glands, and likewise perish. In these respects the arrangement comes under the head of those recently illustrated by Kerner, for the exclusion of unwelcome guests from the blossoms. And this may be extended to the flies also, which might reach the blossom on the wing, but are attracted rather to the glands beneath, to their own destruction. Professor Gray requests those who have good opportunities of obtaining *Mentzelia ornata*, and its much more common relative, *M. nuda*, both of which occur in the Western prairies and plains, to investigate the matter and ascertain whether this charge of cruel behavior is well founded.

CACTUS SPINES.—The spines must, says Moseley in his "Notes of a Naturalist," be a most efficient protection to the cactus from being devoured by large animals. "I have often noticed that if one approaches one's hand slowly toward some of the forms with closely set long spines, doing it with especial care to try and touch the end of one of the spines lightly without getting pricked, one's hand always does receive a sharp prick before such is expected, the distance having been miscalculated. There seems to be a special arrangement in the color of the spines in some cases, possibly intended directly to bring about an illusion, and cause animals likely to injure the plant to get pricked severely before they expect it, and thus to teach them to shun the plant. While the greater length of the spines next the surface of the plant is white, the tips are dark colored or black. The black tips are almost invisible as viewed at a good many angles against the general mass as a background. The spines look as if they ended where the white coloring ends, and the hand is advanced as if the prickles began there, and is pricked suddenly by some unseen black tip. The experiment is easily tried in any cactus house at home."

HYBRID SHAD.—Mr. Seth Green has recently called attention to the fact that it has been customary for the last four

years at the shad hatching works on the Hudson River, whenever an opportunity offered, to impregnate the spawn of the shad with the milt of the white bass. He says that these eggs have hatched out in quite as large a percentage as those impregnated with the shad milt. The young fish look very much like small shad, but their actions are so entirely different that they are readily distinguishable while in the hatching boxes. The attention of fishermen and others is particularly called to the fact that such hybrids now exist in the Hudson, and they are requested if any such be caught to make known the fact through the papers or otherwise, describing as particularly as possible the appearance, characteristics, etc., of the strange fish.

Correspondence.

EDISON'S ELECTRICAL GENERATOR.

To the Editor of the Scientific American:

The letter of Mr. Upton, on page 337, is far from being satisfactory, at least to myself, for it tends to frustrate the realization of the plans I had suggested of relieving Mr. Edison from the appearance of having put forth a preposterous claim for his electric generator. It has almost brought me into the thick of a controversy; I barely escape and reserve my valor for another day. I protest that up to this time I do not know that there is any disagreement between Mr. Edison and myself. Mr. Upton is indeed Mr. Edison's assistant, and his letter purports to be authorized, and yet I cannot find anywhere irrefragable proof that Mr. Edison is the author of the preposterous claim, or that he ever indorsed it. I believe it is best, indeed, as I did in my article on page 305, to assume, until its falsity is proved, that Mr. Edison in the matter of that preposterous claim, or anything else, has not treated with indignity the revered memories of Ohm, Faraday, and the other fathers of electricity. Mr. Edison, like myself, appears to love peace and quietness, and perhaps the guilty author of that preposterous claim will never be discovered and punished. The disagreement which so far is developed is between Mr. Upton and myself only, and it will not long continue if he will take my advice.

The matter in Mr. Upton's letter which is offered as especially pertinent to the preposterous claim is comprised in the two following sentences:

1. "The writer of the article (on page 242) simply stated that the machine was so constructed that when used at its normal capacity the exterior resistance shall be nine times as great as the internal, so that ninety per cent of the power of the current could be used outside."

2. "Yet all that was claimed in the article (page 242) was perfectly true, and has been carefully verified."

I have not been able to satisfy myself as to what are the intent and meaning of sentence 1. I cannot find out what "normal capacity" is. I cannot find out what the thing is which was simply stated; why did not Mr. Upton state it simply? Among various theories of the intent of sentence 1 which I have worked out, the most plausible is, that the sentence is a device like those terrible engines which Knickerbocker, in his history of New York, relates were employed by the ponderous Dutch warriors. This theory derives confirmation from the fact, which appears on page 308, that Mr. Upton found it a fair thing to fire, without warning, at short range, and point blank, hot shot of Calculus (!) right into a gentleman by the name of Weston.

But sentence 2 is direct, explicit, and emphatic. It is so admirable in its way that I quote it again: "Yet *all* that was *claimed* in the article was *perfectly* true, and was *carefully* verified." Now, as nothing was claimed (on 242) but what is covered by the preposterous claim, this latter is signed, sealed, and indorsed; it is represented as having been verified; it is reasserted strenuously. Did Mr. Upton pen that sentence, with the demonstration on page 305 before his eyes?

I reproduce, from page 242, the preposterous claim: "Mr. Edison claims that he realizes ninety per cent of the power applied to this machine in effective external current," and thereupon soon follows the explanation that the great economy is due to the employing of a resistance ratio of 1 : 9. For the demonstration of the fallacy of this I refer to page 305.

I might stop here, far I have said all that is required concerning the matter of the preposterous claim. Mr. Upton introduces several other and extraneous things which are calculated, like that sentence 1, to befog and lead astray the hasty reader, and I shall therefore briefly notice them. The larger part of the letter is devoted to remarks which are aimed more or less directly at myself personally. The general effect of these is substantially that of the trite retort, you're another; but I meet them in detail by pointing out that a part are intended to show that I had overlooked something important, and the rest that I use technical terms ignorantly and recklessly.

1. After a very ingenious prelude, in which I am made to take a rather funny part, the following climax is reached: "It seems never to have occurred to the doctor that it is in the power of the maker of the machine to exert this 'moral suasion' on the wire covering the armature, so that it shall be more effective and redouble its exertion when greater resistance is offered for it to overcome." Mr. Upton is correct; it really never did occur to me. But feeling that such a confession, on account of its brevity, is rather weak, I append the remarks of one whose opinions are worth their weight in diamonds, and are the delight of the world: "If so be ye overhaul yer masheen, tack on yer armycheer a leetle more wire, and make them irons, which ye call magnets, a leetle heftier, why then yer masheen will be bigger; and howbeit ye do these things, why ye'll have a bigger masheen. Bigger, did I say? No! Why? For the bearings of the observation is in the application on it." This is perhaps one of Bunsby's greatest efforts.

2. Mr. Upton neatly gets round to the remark that I deliberately state that current and foot pounds are the same, that energy is directly proportional to the current, etc., and he corrects and instructs me by remarking that "foot pounds are always measured by the square of the current," etc. Moreover, he says: "Dr. Seeley's distinction of outside from inside current seems to me ridiculous." Mr. Upton, no doubt, made himself quity merry at the discovery of all these blunders of mine. Now I reply: Mr. Upton would not have discovered those blunders unless he had been looking for them; the wish is father to the thought. I do not think anybody else has found them, or is likely to find them. When we are obliged to write in the telegramic style, as we are when limited as to time and space, we spontaneously take up abbreviated expressions which hypercritics might object to. Thus we may use the letter C for current or strength of current or energy of current, and no one but the hypercritics will misunderstand or complain unless some positive ambiguity results. Life is too short to write with a view of satisfying the hypercritics. I might quote many precedents for the expressions I used, but I content myself with a single one, for the reason that it is from an authority which, I am sure, Mr. Upton greatly respects; the authority, please understand, is not Mr. Edison: possibly it is Mr. Upton himself. If Mr. Upton will turn to page 242 he will find thereon the preposterous claim as originally propounded, and he will observe that the last two words are "external current." How is it now? Will Mr. Upton ever again say, "the distinction of outside from inside current seems to me ridiculous?"

After finishing my case, Mr. Upton goes on: "In conclusion, I may state that the methods which are employed for testing Mr. Edison's machines were fully described in a paper read by me (in August) at the Saratoga meeting of the American Association. At that time (in August), as now, full results were withheld until Mr. Edison was fully satisfied with the performance of the machine." I find in this pretty plain evidence that Mr. Edison did not—and this I have contended for from the first—put forth the preposterous claim. He had full tests in August as well as on October 11th, and of course he knew that he did not realize that 90 per cent; if he had realized it, he would have been fully satisfied with the performance of his machine, for his machine would be the greatest invention of all time.

Mr. Upton concludes by mentioning that Mr. Edison hopes soon to have a machine with a resistance ratio of 1 : 20. I trust this is not quite true. It would be almost a public calamity if Mr. Edison should employ his great talent on such a puerility. I quote again: "His machine is so made that it would be impossible to use it with the same resistance outside as inside, as it would heat the wire on the armature so as almost to burn it, by carrying a current so much in excess of that for which it was intended." The truth of this must be evident to any one who is a tolerable expert on machines; but I quote it as further evidence that Mr. Edison is not the author of the preposterous claim, and to raise the query whether we cannot relieve Mr. Upton also from suspicion.

A few weeks since (suppose) the startling announcement was made in the papers that X, a dear and distinguished friend of mine, had lifted himself over a tall fence by pulling on his boot straps. Many respectable people, influenced mainly by their exalted and often proved faith in the ability of X, accepted the announcement as true; for my friend was an eminent authority and exceedingly expert in the matters relating to the alleged achievement. The hopeful people at once began speculations on the applications of X's discovery to rapid transit and other great projects. The larger part of the community, however, remembering something of the little lessons in natural philosophy of their school days, denied the claims set up for X, and they scoffed at him. At this juncture it seemed to me a proper thing and a duty towards a friend and to the public to make an explanation. I said that the feat proclaimed was really an impossibility, that it was a contradiction of the law of action and reaction; that the pulling up on the boot strap would be precisely balanced by the pressing down of the feet in the boots, etc.; that my friend was of too good sense to claim impossible performances; that the announcement was an exaggeration, or came from a wicked partner, etc. My explanation was calculated to pacify the scoffers and to make all lovely again. My friend had no call to say anything, unless to indorse my explanation or to turn the whole affair into mild but pleasing entertainment by relating how the announcement originated in a little badinage of his, in which he proposed to lift himself over the fence, by pulling on the boot straps of his carriage after slinging them over a pulley, etc. But the affair is going to terminate differently and sadly. For a gentleman by the name of Z, who is an assistant (some say a partner) of X, has written a letter to the public which purports to be authorized by X, in which the original claim is reasserted and enlarged. Mr. Z says: 'Spring, at its normal capacity, is the pleasantest season of the year. X never denied Newton's laws. Yet all that was claimed in the papers was perfectly true, and has been carefully verified. X has positively lifted himself over a fence ten feet high, and it may be mentioned that he hopes to lift himself over a fence 20 feet high. There are doors in the fence, but they have patent locks on them. (What does this mean?) This S isn't much of a doctor, and I wouldn't trust him with a sick cat. He spells Jerusalem with a G, and his name is mentioned in connection with a neighbor's hen roost." This letter of Z's is a great trouble to us, but I protest and persist that X is innocent. No one can foretell what is to come out of all this embarrassment.

But all this is supposition. Perhaps it isn't apropos of anything. "The bearings of an observation is in the applications on it."

CHARLES A. SEELEY.

A Note from Mr. Edison.—The Hughes Microphone and the Blake Transmitter.

To the Editor of the Scientific American:

In reference to the communication from T. D. Lockwood, which appeared in the SCIENTIFIC AMERICAN (No. 21), November 22, 1879, regarding the carbon telephone, I wish to say that his statement that the scientific men of Europe have supported the claim of Hughes that the microphonic action is different from the carbon telephone, is absolutely false, and as a fact just the contrary is the case. Also that the Patent Office has declared that the Blake transmitter filed in the Patent Office in 1879 infringes several of my patents filed in 1877. In fact there is not the slightest difference between the carbon transmitter and the so-called Blake transmitter, except in size of parts and delicacy of adjustment.

T. A. EDISON.

Menlo Park, N. J., November, 1879.

CROSS-BREEDING AMONG FISH.

Mr. Robert B. Roosevelt, so well known in connection with fish breeding, is responsible for some surprising assertions with regard to the inter-crossing of distinct species of fish. Some two years ago the eggs of a shad were placed in a pan of fresh water which could not have contained any milt of the male shad. This done, the eggs were mixed with the milt of a striped bass and they were immediately fertilized. They were then placed in the shad-hatching boxes, and fully 10,000 young cross-breeds were the result. They were turned into the river at the proper time, and it is not yet time for them to return, if they follow the customs of their mother.

That the hybrids are likely to thrive and breed is thought probable after the perfect success that has followed the crossing of the California salmon and the common brook trout. Mr. Roosevelt says: "We have crossed fifteen or twenty different breeds, and all successfully, and I can assure you that the result is a strong argument in favor of Darwinism, for it shows that all fish may possibly have grown out of one or two varieties. This would account for what is called the 'land-locked salmon' which is found in lakes having no communication with the sea. The object of this crossing and breeding is to improve the fish, just as they cross neat cattle and horses, and even fruits and flowers. The result will be to make fish food plenty, and to add a large number of 'queer fish' to the number already in existence."

THE INTERNATIONAL DAIRY FAIR.

The second annual International Dairy Fair in this city, to be opened in the American Institute building, December 8, promises to be the largest and finest exhibition of the kind ever held in this country. Nearly three thousand entries have already been made by intending exhibitors, and ten thousand dollars will be given as premiums. It is expected that at least 300 specimens of fine cattle will be exhibited, representing the most celebrated herds in the country. Especial attention will be given to this department of the fair. In addition to many novelties there is promised an elaborate comparison of the methods of butter and cheese manufacture as employed a hundred years ago and to-day in our best factories.

STEAM TOWING ON THE ERIE CANAL.

The first through tow on the Erie Canal from Buffalo to Rochester, by the steam cable towing system, arrived at the latter city, November 18. The tow consisted of five canal boats, carrying 1,200 tons of grain. The distance, 96 miles, was covered in 39 hours, a saving of 23 hours as compared with horse power. It is expected that the cable system will be completed the entire distance from Buffalo to Troy, 345 miles, shortly after the reopening of navigation in the spring. The existing canal boats will be used without alteration, and the boats will yield a larger revenue owing to the saving of time on each trip. The traffic of the canal this year has been unusually great, and it is expected that the new system will largely increase its capacity.

New Military Projectile.

Experiments have recently been carried on at Grenoble to test the efficacy of a new apparatus, made by M. Lamarre. The invention consists of balls to be projected by guns of a fortress for the purpose of throwing a strong light on the enemy's position during the night; the principal object being to prevent the digging of trenches or the performance of other military operations. Shortly after leaving the cannon, the Lamarre fire ball discharges a light sufficiently bright, and lasts long enough, to enable guns to be pointed at the works. The projectile is, moreover, provided with a grenade, which explodes after a certain time, and is designed to keep the enemy's troops away and prevent them from putting out the unwelcome light.

GLASS TUBING.

The manufacture of glass tubing is surprisingly simple. The glass blower takes a small quantity of melted glass from the pot with his blowing tube, rolls it slightly on a marble slab to give it a cylindrical form, he then adds a small quantity of glass from the same pot, and blows the enlarged mass while rolling it, taking great pains to keep the shape cylindrical. If tubes of large caliber are required, the inside diameter of the cylinder is enlarged, and the glass is allowed to cool slightly before drawing. For tubes of very small caliber, such as thermometer tubes and other capillary tubes, the internal diameter of the cylinder is decreased and the glass is used very warm.

In making a piece of glass tubing the assistant places a ball of glass against the end of the glass cylinder by aid of his blowing tube. Now the men, each holding an end of the glass cylinder by means of their blowing tubes, begin to separate, walking backward. The cylinder is thus lengthened, and at the same time made smaller in diameter, and the diameter, of course, depends upon how much the tube is drawn out.

When the tube has attained the right size it is generally too warm and soft to admit of laying it down without destroying its shape; it is therefore cooled by means of a fan, as shown in Fig. 1. When it becomes sufficiently cool it is laid upon a series of equidistant parallel wooden blocks of uniform height, where it remains until it becomes cold. It is then cut into lengths with a diamond or a file. If the tubes are to resist great pressure or changes of temperature, they are annealed with great care. They are sometimes plunged into boiling linseed oil and slowly cooled.

FIG. 1.—COOLING GLASS TUBES.

Reading Room of the British Museum.

The dome of the British Museum reading room, in which the electric light is now used, is 140 feet in diameter and 106 feet high. In this dimension of diameter it is only inferior to the Pantheon of Rome by 2 feet; St. Peter's being only 139; Sta. Maria, in Florence, 139; the capitol at Washington, 135½; the tomb of Mahomet, Bejapore, 135; St. Paul's, 112; St. Sophia, Constantinople, 107, and the Church at Darmstadt, 105.

The new reading room contains 1,250,000 cubic feet of space; its "suburbs," or surrounding libraries, 750,000. The building is constructed principally of iron, with brick arches between the main ribs, supported by twenty iron piers, having a sectional area of 10 superficial feet to each, including the brick casing, or 200 feet in all. This saving of space by the use of iron is remarkable, the piers of support on which ..me rests only thus occupying 200 feet, whereas the piers of the Pantheon of Rome fill 7,477 feet of area, and those of the tomb of Mahomet 5,593 feet. Upwards of 2,000 tons of iron have been employed in the construction. The weight of the materials used in the dome is about 4,200 tons, namely, upwards of 200 tons on each pier.

The uprights or standards of the bookcases in the British Museum reading room are formed of wrought iron, galvanized and framed together, having fillets of beech inserted between the iron to receive the brass pins upon which the shelves rest. The framework of the bookcases forms the support for the iron perforated floors of the gallery avenues, and which are generally 8 feet wide, the central 6 feet being appropriated to the perforated floor, and the remainder being a clear space between the back of the books and the flooring, by which contrivance the light from the skylights (in all cases extending to the full width of the avenues) is thrown down the back of the books on each story, so that the lettering may be easily discerned throughout the book ranges. The shelves are formed of iron galvanized plates, edged with wainscot and covered with russet hide leather, and having a book fall attached. They are fitted at each end wih galvanized iron leather, covered, and wadded pads placed next the skeleton bookcase framing, to prevent injury to the binding when the books are taken out or replaced. Between these pads the skeleton framing of the cases forms an aperture by which a current of air may pass and ventilation be kept up throughout. The shelves rest upon brass pins, the holes for which are pierced at three quarters of an inch apart from center to center; but by a contrivance in cranking the shaft of the pin, which may be turned upward or downward, this interval is practically halved, and the position of the shelves may be altered three-eighths of an inch at a time.

The reading room contains three miles lineal of bookcases, eight feet high; assuming them all to be spaced for the averaged octavo book size, the entire ranges form twenty-five miles of shelves. Assuming the shelves to be filled with books, of paper of average thickness, the leaves placed edge to edge would extend about 25,000 miles, or more than three times the diameter of the globe!

Slag Boiler Covering.

Mr. Franz Buttgenbach, the well known metallurgist, gives the following method for the utilization of blast furnace cinder as an insulator for steam pipes, etc.: Mix 150 parts of cinder dust, 35 parts by weight of fine coal dust, 250 parts of fire clay, and 300 parts flue dust, with 10 parts of cow's hair, add 600 parts of water into which 10 to 15 parts of raw sulphuric acid has been poured, and make a stiff dough of the whole. This is thrown in small amounts upon the warmed pipe, hardening rapidly. Upon this rough coat a second, third, etc., is laid, according to the thickness which is to be used. By the action of sulphuric acid gypsum is formed, and the silica, rendered free, hardens. The mass becomes as hard as porcelain, and is still porous. It adheres firmly, and never cracks. Mr. Buttgenbach states that he has tested its merits by ten years' use, and has found it to meet all requirements.

AGRICULTURAL INVENTIONS.

An improvement in sulky-plows has been patented by Mr. William J. Meharry, of State Line, Indiana (Sheldon, Illinois, P. O.). The object of this invention is to furnish an improved sulky attachment for plows, which shall be simple in construction, may be readily attached to any ordinary plow, will materially lighten the draught, and will allow the plow to be readily controlled.

Messrs. John J. Howell and Osnel H. Wienges, of Fort Motte, S. C., have invented an improved handle, which is so constructed that it may be applied to hoes, rakes, and other similar garden and farm implements, and which may be easily and quickly detached from one implement and attached to another, and when attached will hold the implement firmly and securely.

An improved farm gate has been patented by Mr. George Johnson, of Waucousta, Wis. This is an improvement in the class of horizontally-swinging farm-gates, which have suitable attachments for holding them at different elevations for the purpose of avoiding snow or other obstruction, while being opened or closed. The invention relates to the construction of the attachments or devices which hold the gate in different vertical adjustments.

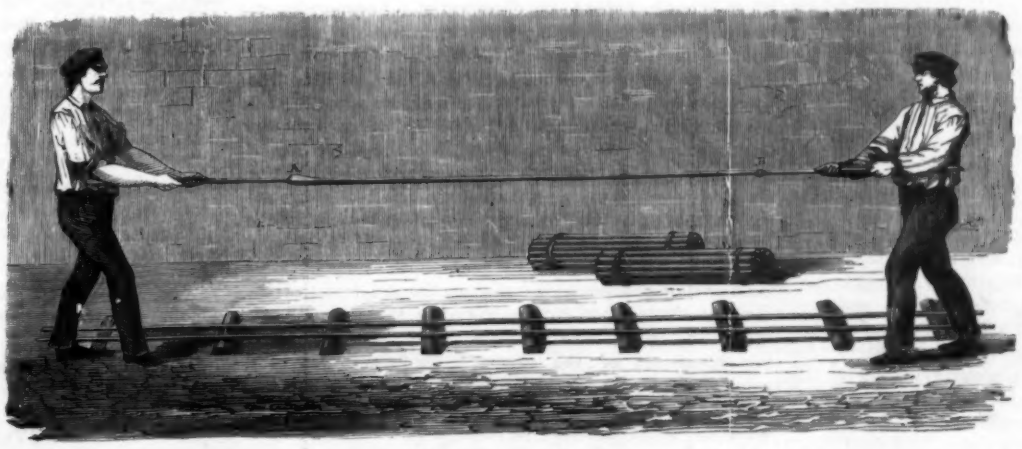


FIG. 2.—DRAWING GLASS TUBES.

NEARSIGHTEDNESS AND THE COLOR OF THE EYES.—M. Nicaté stated, at the meeting of the French Society for the Advancement of Science, that as one of the results of his examination of 3,434 eyes in relation to myopia, at Marseilles, this defect was observed far more frequently in light than in dark eyes, blue and gray eyes furnishing 18 per cent, and black and brown eyes only 11·27 per cent.

Purifying Gelatine.

Impurities in gelatine may be classified under two heads—mechanical and chemical—the latter being far more difficult to remove than the former, inasmuch as they are more or less in combination with the material itself. Fortunately they do not appear to exert the same injurious action on the emulsion as the mechanical, which, although simply in a state of suspension, are yet exceedingly difficult to remove by simple filtration, especially after the emulsion is formed, as many of them are in quite as fine a state of division as the bromide itself; hence it is clear that any means which may be adopted to remove the one will also remove the other.

The mechanical impurities in gelatine principally consist of lime in the form either of the sulphates, carbonates, and phosphates, fat or grease, sometimes animal fiber, and always that very indefinite compound "dust." This latter impurity is generally present in considerable quantity owing to the sheets or flakes, while in the jellied form, being exposed on nets of string or wire in a strong current of air to dry, when, as a matter of course, any dust that comes in contact with them adheres and dries into the gelatine. In some of the English manufactories wire nets are employed, but on the continent those made of string are principally in use, and fibers of that material adhere to and are detached with the gelatine. It is said that these nets are greased to prevent the flakes from sticking. If this be the case it will account for some of the fat generally present in gelatine. We are told that it is the custom with some of the continental manufacturers to wash the surface of the sheets of their finest kinds with warm water after they are dry so as to remove the extraneous surface matter.

Although, as we have said, it is almost impossible to remove the insoluble matter by mere filtration, owing to the viscousness of the solution, yet it may be entirely eliminated by adopting the process commonly employed in the culinary art for clarifying jellies. This consists of mixing with the solution of gelatine some albumen of white of egg, and then raising the temperature sufficiently high to coagulate the albumen, which in coagulating imprisons the insoluble particles. The whole is then put into a flannel bag, and suspended in front of a fire, when the solution passes through perfectly clear and transparent, even if an opaque sample of gelatine have been used, and at the same time all fatty particles will be retained by the coagulated albumen. In practice, however, it will be found very difficult to treat successfully thick solutions in this way, as they will not pass through the strainer in the same manner as thin ones, such as are used for jellies, and also that strong solutions set much quicker and at a higher temperature than weak ones, so that some other plan must be adopted to avoid the necessity of filtering the solution if a strong one require purification.

The method we have employed with perfect success does not require filtration at all, yet the solution is rendered perfectly bright and transparent, and free from all solid particles as well as fatty matters. For this purpose the gelatine to be purified is placed in cold water until it has become swollen. It is then transferred to a beaker placed in a water bath heated to a temperature of 110° Fah. —not higher—until it is dissolved; then some well-whisked white of egg is stirred in. The proportion we have used has been two ounces of albumen to each four or five ounces of dry gelatine. Now, with a whisk, or, better still, one of the American egg beaters, convert the whole into froth. To do this easily it may be necessary to heat the solution somewhat, so as to render it more limpid; but care must be taken that it does not rise beyond 120° Fah., otherwise the albumen will be coagulated before its time. After the whole is converted into froth the temperature of the water bath must be quickly raised to nearly boiling point, and then allowed to remain undisturbed for some time.

As the albumen coagulates it will rise to the surface of the solution, carrying with it all the solid impurities, leaving the lower part quite clear. This may take some little time, according to the strength of the solution; but the temperature must be maintained until it is clear. It may then be allowed to cool, and the whole turned out (which may be easily done by placing the beaker in water for a few seconds and then inverting it), and the top part cut off and rejected. The other part may then be used direct for the emulsion, or it may be cut into thin slices and dried in an atmosphere free

from dust, and preserved for future use. The drying may be much facilitated by digesting the thin slices in strong alcohol, so as to displace the greater part of the water before commencing to dry, and by this means the chances of its becoming contaminated with dust will be much reduced.

The object of converting the greater part of the solution into froth is this: If the albumen was simply stirred in and then coagulated it would remain in suspension, owing to the density of the solution; but, when the whole is converted into froth, the air bubbles as they rise to the surface carry the coagulated albumen, together with its imprisoned impurities, before it. As an example of the efficacy of this method of purification we may mention that we once mixed some gelatine with a solution of Indian ink which had been passed through filtering paper, and then treated it in the manner described, the result being that the whole of the coloring matter was removed with the albumen, which floated on the top like soot, while the lower portion was not only transparent, but perfectly devoid of color.

This experiment not only proves the efficiency of the process, but also shows that it is impracticable to purify the emulsion with albumen after it is made, as has been suggested, for the purpose of removing the coarser particles of bromide, because the whole would be removed in the same manner as the coloring matter of the Indian ink was.—*British Journal of Photography.*

Letters Patent.—How and in What Manner they can be Taken Out.

In this age of improvements and inventions the subject of patents is of great interest. The laws which govern patents are among the most important on the statute books looking to the protection of industries, as they grant inventors, their heirs and assigns, the exclusive right for a specified period to new discoveries and inventions of a novel and useful character. Every invention or discovery to be patentable must possess the merit of either novelty or utility. A patent will not be granted to an applicant for an article discovered and invented by another, but inventors will not prejudice their rights by allowing the public sale of that invention for two years before applying for a patent, and a valid patent will not be issued in case this use extends over a longer period. A "prior invention" does not hold good, if the party has simply conceived the idea of the thing patented; it is necessary that it should be reduced to a practical form or complete invention before a claim can be established. Whoever restores an abandoned or lost art or invention may obtain a patent for it.

An invention patented in a foreign country can receive a patent in the United States, if it has not been in public use two years prior to the application, but the American patent will not continue beyond the time granted by the foreign patent. In determining

WHETHER AN INVENTION IS NEW,

it is only necessary to ascertain if it is different from anything previously patented. In deciding the question of novelty it is necessary to decide whether an invention is really novel, or whether it consists in a double or analogous use of something already known. For instance, a patent will not be issued to a person who first applies to railroad cars a kind of a wheel previously used for other conveyances. Neither can the discovery of a principle, a natural law, scientific truth, or property of matter be a subject of a patent. But whoever makes a new and useful application of any of these things by embodying the principle of the law in mechanism, or describing a new process by which the discovery may be of practical utility, may obtain a patent for his invention, which consists not in the abstract principle, but in its practical application.

Persons wishing to obtain letters patent usually apply to a solicitor of patents or attorney, and furnish him with a model of the invention desired to be patented, except in cases of designs, compositions, and processes. The petitioner takes oath that he believes himself to be the original and first inventor of the invention, and that, to his knowledge, it has not been known or used before. Accompanying this petition and oath must be a model of the invention if the case will admit of it, with drawings and specifications. The application must be signed by the inventor unless he is dead, when it must be signed by his executor or administrator. The specification is a full description of the invention, in writing, and the manner and process of making and using it. The description is followed by the claim, in which the applicant must particularly specify the part, improvement, or combination which he claims as his own invention and discovery. Where there are drawings the specification must refer by letters and figures to the different parts. In the case of the composition of matter, specimens of the composition and of the ingredients sufficient in quantity for the purpose of experiment must accompany the application.

THE CHIEF OBJECTS OF THE SPECIFICATIONS

Are to make known the precise nature of the invention, and to enable the public from the specification itself to practice the invention after the expiration of the patent. The object of the claim is to fix with accuracy the extent of what is claimed as new. It is sometimes fatal to a claim to call an invention a machine when it is a process, and it is of the utmost importance to the inventors that the specifications are plain. The petition, oath, model, specification, drawing, etc., are forwarded to the Patent Office at Washington by the solicitor or attorney. The Patent Office, as those who have seen it are well aware, is one of the most notable buildings in the nation's capital, as it is one of the most important. Here are preserved all records, books, models, drawings, specifications, etc., pertaining to patents. The office is under the supervision of the Secretary of the Interior, but the Commissioner of Patents is the chief in charge of the office. The officers consist of a commissioner, assistant commissioner, and three examiners-in-chief, besides one chief clerk and examiner in charge of interferences, and a host of primary examiners. These primary examiners are men versed in some special department of mechanics, etc., and models, drawings, specifications, etc., are given to them for examination, with due reference to their special qualifications.

If an applicant is dissatisfied with a decision, he can be heard by the board of examiners-in-chief, and then, if still dissatisfied, before the Commissioner on appeal. Appeals from the Commissioner can be taken in all cases, except interferences, to the Supreme Court. Where an inventor is not ready to file a complete specification, and desires further time, but wishes to secure his right, he can file a caveat, which will be placed in the secret archives of the Patent Office; and if there be any application within a year for anything which appears to interfere with his claim, he shall have notice, and may appear and prove priority; and by a second caveat he may renew it for another year. Patents can be procured in foreign countries, and a great many are taken out in England, Canada, France, Belgium, and Germany.

THE PATENT OFFICE IN WASHINGTON

Is more than self-supporting, and to-day is said to have at least $1,000,000 to its credit. Last year there were 20,260 applicants for patents, and 12,354 patents were granted, besides 1,455 trade marks and 492 labels. Of the patents, 832 were held for the final payment of dues. The cost of obtaining a patent is usually about $60, $25 of this amount being the fee of the solicitor and the balance is paid at the Patent Office. The State receiving the largest number of patents per capita last year was Nevada, but usually the order is as follows: Massachusetts, Connecticut, Rhode Island, New York, and the District of Columbia. It is to be expected that Massachusetts and Connecticut will stand at the head of the list. The intuitive ingenuity of the Yankee is constantly designing something new and exploring the labyrinths of science and art in its efforts to lighten the labor of man, and it will be a long time before he can be ousted from his position at the head of designers and inventors.—*Boston Globe.*

Fire Losses.

The statistics of fires for the month of September show that the losses by fires reported in the United States amounted to $5,349,300, and in Canada to $264,800. Of the United States loss, the insurance companies paid $2,298,200, and of the Canadian loss $165,000, or less than one half. The loss for the corresponding month of last year was $790,500 less than the aggregate amount above given. This total loss of $5,349,300 was distributed, says the *Fireman's Journal*, generally throughout the States and Territories, New York State suffering the most severely, her loss being $767,700; Illinois comes next, with a loss of $439,600; Iowa lost $322,500, and Massachusetts $281,600. Dakota had an exceptional fire at Deadwood, where the loss was $1,070,000, which is not included in the classification of average losses. For the nine months ending with September, the recorded losses of the United States amounted to $61,150,100, and in Canada to $6,014,800—an aggregate of $67,164,900. The aggregate losses for the same period last year were $50,626,500, showing a gain for 1879 of $16,538,400. Should the last three months of the year only equal for each the loss of September, the recorded loss for the year will be $84,007,200. But it is estimated that one third of the actual losses are not recorded, so that the estimate heretofore made that the annual loss by fire is $100,000,000 is not far out of the way.

The statistics for the past ten years show, excepting great conflagrations, a yearly increase in the fire losses of the country. This is positive demonstration that the means for controlling fires have not kept pace with the building operations of the country. Including the great conflagrations, the fact becomes apparent that improvement in fire extinguishing machinery has not kept pace with the latest methods of construction. As a matter of fact, the means for fighting fires in the seven, eight, or nine story buildings of modern times, constructed of the most inflammable material, are no better than they were twenty years ago, before the era of tall buildings, and when better methods of construction prevailed. The steam fire engine is the only real advance in fire extinguishing machinery that has been made within the present generation, and the capacity of these has not been increased to accord with the modern style of architecture. Machinery that is equal to fighting a fire in a three story building is wholly ineffectual when the flames are raging a hundred or more feet above the street level. That our engines have not greater capacity is not the fault of the manufacturers. The demand has been for light engines that could be quickly drawn to a fire, rather than for those of great capacity in throwing water. As a matter of fact, the light engines are more serviceable three times out of five. It is only in those cities where tall buildings are numerous that more powerful engines are required, and in those greater importance is laid upon the ability of the lighter ones to get quickly to a fire and put it out before it gets headway, than upon great volumes of water to suppress one that is well agoing. Preventions of conflagrations, rather than their extinction, is relied upon. This would be all well enough if it could always be trusted. But conflagrations will come in spite of every precaution, and, in such an emergency, the engine that can throw the greatest volume of water steadily for all the time required is the best one.

But to return to the statistics, which show an annual waste of $100,000,000 of property every year. This amount of actual values, the product of the people's industry, is thrown away yearly. There is no return for it in any shape. Insurance companies may make good individual losses, but the money must come from the pockets of other individuals, and, eventually, is paid by the producing classes. It would be far better if we could take $100,000,000 a year in new, crisp, greenbacks from the National Treasury and burn them up, if by that means we could save for business purposes the property destroyed by fire. But suppose Congress should appropriate this sum of money to be burned up every year—what a howl of indignation would be raised by the taxpayers of the country! How they would denounce the wastefulness of our legislators, and how quickly they would relegate them to private life. But would it be any worse for Congress to thus squander the substance of the nation than it is for the careless and wasteful taxpayers to do it? The waste is the same, and careful and prudent taxpayers are forced to contribute to make up the losses of those who are neither the one nor the other. What we want is better legislation to control the erection of buildings, and legislation to prevent insurance companies from encouraging incendiarism by paying more for property that is destroyed by fire than it was worth while standing. In other words, the payment of losses by insurance companies should be restricted to two-thirds the value of the property destroyed. With such a law in force, property owners would be compelled to carry one-third of the risk themselves, and this would destroy all motive to incendiarism, and induce prudence and care in the management of property. Such a law enforced rigidly in every State would reduce our fire losses more than fifty per cent the first year.

Telegraphy in France.

By the end of the present year, of 87 chief towns of departments, only 26 will not be provided with direct telegraphic communication with Paris. These 26 towns communicate through intermediate offices. The total number of direct wires from the French capital to provincial centers is 113, and several of these centers have more than one such wire. Thus, Amiens has 2; Bordeaux, 3; Marseilles, 4; Montpellier, 2; Nantes, 2; Toulouse, 2; Trouville, 2; and Versailles, 39. Twenty-five of these lines are subterranean. As regards direct wires to foreign centers, Paris has one to Amsterdam, one to Antwerp, one to Basle, three to Berlin, one to Berne, one to Bergeux, three to Brussels, one to Cologne, one to Florence, one to Geneva, nine to London, one to Metz-Hamburg, one to Milan, one to Mülhausen, one to Rome, one to Strasbourg, one to Turin, and two to Vienna. There is also a direct submarine wire from Marseilles to London.

The Telegraphic System of the World.

The system of telegraphs in Europe comprised, at the end of 1877, 268,809 miles of lines, and 769,768 miles of wires. There were 19,627 government telegraph stations, and 12,708 railway and special stations. The number of employés amounted to 61,984, and the number of instruments to 41,708. The number of paid messages was, in round numbers, 86,000,000, of which 20,000,000 were international dispatches. The number of other telegrams forwarded amounted to about 7,000,000. M. Newman Spallart gives the following statistics for the other parts of the world. In America (1875 to 1877), 114,157 miles of wires; 8,756 stations; 23,000,000 telegrams. In Asia (1875 to 1876), 24,521 miles of wires; 489 stations; 2,300,000 telegrams. Australia (1875), 23,582 miles of wires; 689 stations; 2,500,000 telegrams. Africa (1874 to 1876), 8,148 miles of wires; 196 stations; 1,200,000 telegrams.

A New Colorado Mining Tunnel.

The Boulder *News and Courier* says: "A tunnel has recently been started at the base of Seaton Mountain, about one mile from Idaho Springs, having a course north 24° east. It cuts at right angles all the lodes, and some of them at a depth of 2,300 feet. Thirty-seven already discovered will be cut by this tunnel, many of them well and favorably known by their rich and abundant production of ores. Of these, the projector of the enterprise has secured thirty-four lodes, and arranged for the purchase of the balance when desirable, thus wisely avoiding any possibility of dispute over titles, surface claims, or side lines in the long hereafter. This tunnel, christened the 'Idaho,' is considered in many respects the largest and best constructed tunnel in the country for mining uses. Bed rock was reached at a distance of 48 feet, at which point the first lode was cut, the vein matter assaying well. Very strong and promising mineral veins have been cut within each successive 25 feet since reaching solid rock. This tunnel, if continued on its course, will reach Black Hawk at a distance of three and a half miles."

MEN of science, students, inventors, and every other class of persons desirous of keeping up with the times should become regular subscribers to this paper. They will find it a paying investment, for the SCIENTIFIC AMERICAN not only contains a record of all the important discoveries and inventions of this country, Great Britain, and other English speaking countries, but translations from the French, German, and other foreign scientific and industrial publications, nearly all of which are received regularly at this office.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

☞ *The publishers of this paper guarantee to advertisers a circulation of not less than 50,000 copies every weekly issue.*

Blake Crushers, all sizes, with all the best improvements, at less than half former prices. E. S. Blake & Co., Pittsburg, Pa.

Comb'd Punch & Shears; Universal Lathe Chucks. Lambertville Iron Works, Lambertville, N. J. See ad. p. 355.

To Thrashing Machine Manufacturers.—The best, cheapest, and most durable Grain Tally. Can be attached to separators. Measures and registers correctly. Shop rights or entire patent for sale. Address A. H. Seavey, North Huron, Wayne Co., N. Y.

Agency Wanted to introduce some Novelty into Canada by a gentleman of ability. Address "Novelty," Aylmer, Ont.

The Friction Clutch Captain will start calender rolls for rubber, brass, or paper without shock; stop quick, and will save machinery from breaking. D. Frisbie & Co., New Haven, Conn.

Flanges, Pulleys, etc. P. Pryibil, 467 W. 40th St., N. Y.

You can get your engravings made by the Photo-Engraving Co. (Moss' process), 67 Park Place, N. Y., for about one-half the price charged for wood cuts. Send stamp for illustrated circular.

Hoisting Machinery of all kinds a specialty.

Castings of Crucible Steel, solid, act same as bar steel. Specialty: Cast Cast Steel Plow Shares. Agricultural Wrought Steels of every description. Write us. Read, McKee & Co., limited, Pittsburg, Pa.

For Sale.—Patent Automatic Planer Knife and Tool Grinder. Also Patent Friction Clutch and Pulley. Address E. S. Fernald, Saco, Me.

A Firm in Scotland, representing a New York Leather Belting House, are anxious to obtain another representation for American goods. Address B. J. H., P. O. Box 2701, New York.

Presses, and Dies that cut 500,000 fruit can tops without sharpening. Ayar Machine Works, Salem, N. J.

For Sale.—One Horizontal Steam Engine, 20" x 48"; one 18" x 42"; one 16" x 36". Atlantic Steam Engine Works, Brooklyn, N. Y.

Wood Turning Lathes. P. Pryibil, 467 W. 40th St., N.Y.

Light and Fine Machinery contracted for. Foot Lathe Catalogue for stamp. Chase & Woodman, Newark, N. J.

Empire Gum Core Packing is reliable; beware of imitations called Phœnix. Greene, Tweed & Co., 18 Park Place, N. Y.

Box-bell, $1 50. Bell, Battery, and Push Button, $3. All first-class. H. Thau, 128 Fulton St., N. Y.

Situation Wanted.—Have had ten years' experience as mechanical superintendent of a large sewing machine business. Understand mechanical drawing, tool making, etc. Best of references. Particulars by letters. Address K., Box 254, Guelph, Ontario, Canada.

The Genuine Asbestos Steam Pipe and Boiler Coverings are the most durable, effective, and economical of any in use. H. W. Johns Manufacturing Company, 87 Maiden Lane, New York, are the sole manufacturers.

A Gentleman, now Foreman in a large Manufactory, possessing inventive ideas, a first-class draughtsman, theoretical and practical machinist, desires to change his present position for one in which he may have a better chance to employ his skill in all kinds of scientific or industrial machinery. Address, for ten days, F. Lambert, 365 12th St., South Brooklyn, N. Y.

See Staples & Co.'s advertisement of Non-Congealable Lubricating Oils on inside page.

Metallic Articles Colored in Single or Rainbow Colors. New Process. High cost metals imitated in cheaper metals. Gardiner M'f'g Co., Newburyport, Mass.

For best Fixtures to run Sewing Machines by Power, address Jos. A. Sawyer & Son, Worcester, Mass.

Thomas D. Stetson, 23 Murray St., New York, serves as Expert in Patent Suits.

The Baker Blower ventilates silver mines 2,000 feet deep. Wilbraham Bros., 2318 Frankford Ave., Phila., Pa.

Wheelbarrows.—The "A. B. C. bolted" will outlast five ordinary barrows. $34 per doz. A. B. Cohn, 197 Water St., N. Y.

Park Benjamin's Expert Office, Box 1009, N. Y. Recipes and information on all industrial processes.

To stop leaks in boiler tubes, use Quinn's Patent Ferrules. Address S. M. Co., So. Newmarket, N. H.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, importers Vienna lime, crocus, etc. Condit, Hanson & Van Winkle, Newark, N. J., and 92 and 94 Liberty St., New York.

The Secret Key to Health.—The Science of Life, or Self-Preservation, 300 pages. Price, only $1. Contains fifty valuable prescriptions, either one of which is worth more than ten times the price of the book. Illustrated sample sent on receipt of 6 cents for postage. Address Dr. W. H. Parker, 4 Bulfinch St., Boston, Mass.

Wright's Patent Steam Engine, with automatic cut-off. The best engine made. For prices, address William Wright, Manufacturer, Newburgh, N. Y.

For Solid Wrought Iron Beams, etc., see advertisement. Address Union Iron Mills, Pittsburgh, Pa., for lithograph, etc.

Presses, Dies, and Tools for working Sheet Metal, etc. Fruit & other can tools. Bliss & Williams, B'klyn, N. Y.

Hydraulic Presses and Jacks, new and second hand. Lathes and Machinery for Polishing and Buffing Metals. E. Lyon & Co., 470 Grand St., N. Y.

Steam Excavators. J. Souther & Co., 19 P.O. Sq. Boston.

Bradley's cushioned helve hammers. See illus. ad. p. 302.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Noise-Quieting Nozzles for Locomotives and Steamboats. 50 different varieties, adapted to every class of engine. T. Shaw, 915 Ridge Avenue, Philadelphia, Pa.

Stave, Barrel, Keg, and Hogshead Machinery a specialty, by E. & B. Holmes, Buffalo, N. Y.

Solid Emery Vulcanite Wheels—The Solid Original Emery Wheel—other kinds imitations and inferior. Caution.—Our name is stamped in full on all our best Standard Belting, Packing, and Hose. Buy that only. The best is the cheapest. New York Belting and Packing Company, 37 and 38 Park Row, N. Y.

For best low price Planer and Matcher, and latest improved Sash, Door, and Blind Machinery. Send for descriptive catalogue to Rowley & Hermance, Williamsport, Pa.

Eclipse Portable Engine. See illustrated adv., p. 318.

Special Wood-Working Machinery of every variety. Levi Houston, Montgomery, Pa. See ad. page 309.

Sheet Metal Presses, Ferracute Co., Bridgeton, N. J.

Latest improved methods for working hard or soft metals, grinding long knives, tools, etc. Portable Chuck Jaws and Diamond Tools. Address American Twist Drill Co., Woonsocket, R. I.

For best Portable Forges and Blacksmiths' Hand Blowers, address Buffalo Forge Company, Buffalo, N. Y.

Diamond Planers. J. Dickinson, 64 Nassau St., N. Y.

Steam Hammers, Improved Hydraulic Jacks, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Sawyer's Own Book, Illustrated. Over 100 pages of valuable information. How to straighten saws, etc. Sent free by mail to any part of the world. Send your full address to Emerson, Smith & Co., Beaver Falls, Pa.

Eagle Anvils, 9 cents per pound. Fully warranted.

Repairs to Corliss Engines a specialty. L. B. Flanders Machine Works, Philadelphia, Pa.

Tight and Slack Barrel machinery a specialty. John Greenwood & Co., Rochester, N. Y. See illus'd adv. p. 30.

Elevators, Freight and Passenger, Shafting, Pulleys, and Hangers. L. S. Graves & Son, Rochester, N. Y.

The Horton Lathe Chucks; prices reduced 30 per cent. Address The E. Horton & Son Co., Windsor Locks, Conn

$400 Vertical Engine, 30 H. P. See page 350.

No gum! No grit! No acid! Anti-Corrosive Cylinder Oil is the best in the world, and the first and only oil that perfectly lubricates a railroad locomotive cylinder, doing it with half the quantity required of best lard or tallow, giving increased power and less wear to machinery, with entire freedom from gum, stain, or corrosion of any sort, and it is equally superior for all steam cylinders or heavy work where body or cooling qualities are indispensable. A fair trial insures its continued use. Address E. H. Kellogg, sole manufacturer, 17 Cedar St., New York.

Emery Wheels for various purposes, and Machines at reduced prices. Lehigh Valley Emery Wheel Company, Weissport, Pa.

Machine Knives for Wood-working Machinery, Book Binders, and Paper Mills. Large knife work a specialty. Also manufacturers of Soloman's Parallel Vise. Taylor, Stiles & Co., Riegelsville N. J

Magic Lanterns and Stereopticons of all prices. Views illustrating every subject for public exhibitions. Profitable business for a man with small capital. Send stamp for 80 page illustrated catalogue. McAllister, Manufacturing Optician, 49 Nassau St., New York.

Patent Steam Cranes. See illus. adv., page 351

National Steam Pump. Simple, reliable, durable. Send for catalogue. W. E. Kelly, New Brunswick, N. J.

Renshaw's Ratchet (short spindle) uses taper and square shank drills. Pratt & Whitney Co., Hartford, Ct.

Electro-Bronzing on Iron. Philadelphia Smelting Company, Philadelphia, Pa.

Improved Steel Castings; stiff and durable; as soft and easily worked as wrought iron; tensile strength not less than 65,000 lbs. to sq. in. Circulars free. Pittsburg Steel Casting Company, Pittsburg, Pa.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co. Box 423, Pottsville, Pa. See p. 349.

Rue's New "Little Giant" Injector is much praised for its capacity, reliability, and long use without repairs. Rue Manufacturing Co., Philadelphia, Pa.

Catechism of the Locomotive, 625 pages, 250 engravings. The most accurate, complete, and easily understood book on the Locomotive. Price $2.50. Send for a catalogue of railroad books. The Railroad Gazette, 73 Broadway, New York.

The only economical and practical Gas Engine in the market is the new "Otto" Silent, built by Schleicher, Schumm & Co., Philadelphia, Pa. Send for circular.

Steam Engines, Automatic and Slide Valve; also Boilers. Woodbury, Booth & Pryor, Rochester, N. Y. See illustrated advertisement, page 285.

Microscopes, Optical Instrm'ts, etc. G. S. Woolman, 116 Fulton St., N. Y.

NEW BOOKS AND PUBLICATIONS.

VAN NOSTRAND'S SCIENCE SERIES. New York: D. Van Nostrand. Price 50 cents.

Numbers 45 and 46 of these reprints are respectively: Thermodynamics, by Henry T. Eddy, C.E. Ph.D., of the University of Cincinnati; and Ice Making Machines, translated from the French of M. Ledoux, mining engineer. The former aims to give a brief and logical exposition of the fundamental and simplest applications of thermodynamics; the latter discusses theoretically the conditions of effective working of the three classes of ice-making machines.

RESUME OF YELLOW FEVER. (Quarantine and Home Sanitation.) By A. Clendinen, M.D.

Abstract of report by Dr. Clendinen, as chairman of Committee of Intelligence, District Society of Bergen County, New Jersey, first printed in the Transactions of the State Medical Society. The author has brought together a good many facts in the history of yellow fever, which he finds well described by Hippocrates, 2,240 years ago. He does not believe that the disease is always imported, and denies the efficacy of quarantine to prevent its occurrence when local conditions are favorable.

A CATECHISM OF THE MARINE STEAM ENGINE. By Emory Edwards. Illustrated. Philadelphia: Henry Carey Baird & Co. 12mo, 374 pages. Price $2.

Offered as a practical work for practical men, especially for young and inexperienced engineers, mechanics, and firemen, who wish to adopt marine engineering as a profession. For such men it is likely to prove very serviceable. They will at least find no trouble in understanding what the author has to say, his language being admirably simple, direct, and free from mathematical or scientific affectation.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) O. R. writes: Your recipe on shoe dressing is very good. I find that the different ingredients give a good black liquid, which makes the leather smooth, soft, and black, but without gloss. Can you inform me how to obtain a gloss? A. Increase the percentage of shellac and ammonia.

(2) H. C. asks how much fall would be required in a ditch to carry the water three miles an hour, provided the ditch is straight. A. The flow of water in the ditch would depend upon the character of the soil and smoothness of the surface. 2. Could you refer me to some reliable work that treats on running water and ditching, etc.? A. "Fanning on Water Supply Engineering" is a good work.

(3) "Atlas" asks how to mount maps on cloth, and best kind of paste and fabrics for purpose. A. Stretch smooth factory cloth upon a frame and coat it with glue size. Before this dries, apply a strong flour paste to the back of the map and lay it smoothly on the cloth. Let it remain until perfectly dry. If the map is to be varnished, apply two or three coats of isinglass size, and after it becomes thoroughly dry flow on a coat of varnish consisting of balsam of fir diluted to the proper consistency with turpentine.

(4) J. P. asks: 1. Can a current of electricity be generated by an electro-dynamic machine, without the use of either a battery or permanent magnets to charge the machine with? A. Yes; see SUPPLEMENT, No. 161. 2. What is the electromotive force of the Grenet battery when first connected? How long after it is put in action will it maintain its strength, and to what extent will the force of current decrease? A. 1·095 volt. The strength of the current diminishes quite rapidly if the battery is allowed to remain in action any considerable length of time continuously. It is not adapted for a continued use, but where a strong current is required occasionally for a few minutes at a time it answers a good purpose. 3. What form of battery best combines strength of current, constancy, and economy? A. Bunsen's, or some of its modifications.

(5) E. M. C. asks: Is there an easy way of distinguishing between 8vo, 12mo, 16mo, 18mo, and other sizes of books, by those not practical printers, and what is it? A. Count the pages between printers' signatures (letters or figures) at the foot of pages.

(6) O. M. S. asks: Is a lightning rod supported upon large insulators and having no ground connection, supported by any scientific authority that you know of? A. No.

(7) J. S. B. writes: The yachts in use here, of which there are many, are built on a flat model. They are very broad beam, the beam in some cases being about 2-5 of the length, and usually light draught. They are without keels, but furnished with center boards. Now, I am thinking of building a yacht, upon a deeper and narrower model, with keel. How will the two compare for speed? And how would it do to make the keel in latter model in whole or part of iron, heavy enough so that ordinarily no other ballast will be needed? My object in this is to bring the center of gravity as much below the water line as possible, as it seems to me that by so doing we would be able to sail closer to the wind without going over. Would my plan have that effect? A. The mere form of midship section does not determine the best model. What you propose would probably be fastest in deep water and strong winds, but the light draught fastest in light winds. The iron keel is good and should be heavy; do not make your cross section too full below.

(8) F. M. D. asks what is the horse power of an engine of 6½ inch cylinder, 14 inch stroke, 70 lb. pressure, 180 revolutions. I am running an engine of that size, there has been quite a dispute about it. One man said it was a four horse, another said 20. I think it about an 8 horse. A. If you are working 70 lb. pressure on the piston, whole stroke, the available power is about 24 horse power. By actual calculation it is 32 horse power; deducting 25 per cent for friction and other losses, leaves 24 horse power

(9) "Inventor" writes: I want to connect an engine or engines to a shaft running 300 or 400 revolutions per minute; how small ought the cylinders to be to give me 8 or 9 horse power, and what size upright tubular boiler will furnish steam? Can I run the engines with success? How many engines are necessary? A. A 6 inch cylinder and 8 inch stroke will give you the power you want. A vertical tubular boiler should have at least 220 feet heating surface. To run at such high speed successfully, everything must be well proportioned and nicely fitted.

(10) J. F. asks: What is the best method of easily and economically separating in large quantities, of salt water, the calcium magnesia, etc., so that the salt will remain pure? A. There are three methods employed for separating salt from calcium magnesia, etc.: *a*, by evaporation of the water by aid of the sun's heat; *b*, in winter by freezing; *c*, by artificial evaporation. The first method is generally used on the coast lines of southern Europe. The arrangement of the salines or salt gardens is as follows: On a level sea shore is constructed a large reservoir, which by a short canal communicates with the sea, care being taken to afford protection against the inroads of high tides. The depth of water in these reservoirs varies from 0·3 to 2 meters. The sea water is kept in the reservoir until the suspended matter has been deposited, and is then conveyed by a wooden channel into smaller reservoirs, from which it is conducted by underground pipes to ditches surrounding the salines, where the salt is separated from the water. The salt is collected, placed in heaps on the narrow strips of land which separate the ditches from each other, and sheltered. As these heaps are left for some time, the deliquescent chlorides of magnesium and calcium are absorbed in the soil, consequently the salt is comparatively pure. If the salt water is derived from salt wells or springs, the brine is immediately boiled down. This boiling generally requires several weeks, the scum being removed and the soda and calcium sulphates deposited removed with perforated ladles. As soon as a crust of salt is formed on the surface of the liquid a temperature of 50° C. is maintained. At this stage the salt is gradually deposited at the bottom of the pan in small crystals, and being removed, is put into conical willow baskets, which are hung on a wooden support over the pan to admit of the mother liquor (which contains the greater part of the magnesium and calcium chlorides) being returned to it. Finally, the salt is dried and packed in casks.

(11) G. S. T. writes: A reservoir is 60 rods distant, descent 40 feet. One pipe of 1¼ inch bore contracted to ¾ inch just at the lower nozzle, the other pipe of 1¼ inch bore for 90 rods, 1 inch bore for the next 20, and the last 20 rods of ¾ bore. Which of the above will convey more water? A. In a 1¼ inch pipe contracted just at the outlet the friction will be least.

(12) T. M. J. asks: 1. Will the water, if conveyed to the boiler in a 2 inch pipe, force itself into the boiler against a greater steam pressure than (say) in a ½ inch pipe? A. No. 2. In "Peck's Natural Philosophy" there is an illustration of how a cask was bursted, by filling the cask with water from the top of a tube 34 feet long. Will the heavier weight of water in a large pipe not add materially to pressure per square inch at the lower end of the pipe? A. No. 3. Could I overcome any resistance in the boiler by letting the water into the boiler through a funnel or a small hole on the principle of an injector? A. You cannot, unless you use an injector.

(13) J. R. H. asks: 1. Can exhausted steam be used to heat up a workshop? A. Yes. 2. In what way does it affect the working of an engine? A. Produces a little back pressure on the piston. 3. And what per cent of power is lost between exhausting through a pipe 20 feet long, and one 120 feet long? A. Difference is not appreciable if pipe is large.

(14) G. E. T.—You will find directions for making batteries in SUPPLEMENTS, Nos. 157, 158, and 159.

(15) W. H. B. asks, Does the microphone strictly magnify the sound or only transmit it? A. It merely transmits it.

(16) C. K. M. asks: 1. What is the best method of magnetizing a rat tail file 15x½? A. Inclose the file in a helix made of about 50 feet of No. 16 insulated wire, and connect the helix with 4 or 6 cells of carbon battery. 2. Can I magnetize it with an ordinary Daniells battery, by wrapping it with insulated copper wire? A. Yes, by using 6 or 8 cells.

(17) S. G McM. asks: 1. Will a telephone that is constructed as described in SUPPLEMENT, No. 142, work when the coil is made of No. 30 wire? If not, will it with No. 32? A. No. 30 wire is too coarse. No. 32 might answer, but the results would not be satisfactory. Use No. 36. 2. What size should the connecting wire be if made of copper? A. No. 18 will do.

(18) A. S. B. asks: How can I take grease out of marble? A. Mix sal-soda with two parts of quicklime in powder, moisten the mixture with soft cold water, coat the marble with this, and let it remain twelve hours. Then wash with water and a little soap if necessary.

(19) J. D. asks: How can I make an alloy of copper which will attach itself to glass, metal, or porcelain? A. 20 to 30 parts finely blended copper (made by reduction of oxide of copper with hydrogen or precipitation from solution of its sulphate with zinc) are made into a paste with oil of vitriol. To this add 70 parts of mercury and triturate well; then wash out the acid with boiling water and allow the compound to cool. In ten or twelve hours it becomes sufficiently hard to receive a brilliant polish and to scratch the surface of tin or gold. When heated it becomes plastic, but does not contract on cooling.

(20) A. L. C. asks why a piece of paper cannot be blown off the end of a tube if it is simply placed over the tube at one end with nothing to fasten it. A. This phenomenon occurs only when the tube has a flange or its equivalent around the discharge opening. The adherence of the paper to the end of the tube is due to a vacuum formed on the surface of the card by the lateral discharge of air. This subject is fully treated in an article on the ball puzzle in SUPPLEMENT, No. 51.

(21) A. H. asks: Where on the globe will the new year 1880 be greeted or welcomed first? A. In New Zealand most probably; possibly a little earlier at some English missionary station in Polynesia. Eastern Siberia is ruled out of the reckoning by the Russian calendar; and our Alaskan islands by their taking their time from San Francisco.

(22) L. P. B. writes: I wish to know what gives the kind of ink used with the hectograph the peculiar bronze luster? A. The ink consists of a strong solution of aniline violet, which crystallizes on the paper in drying.

(23) W. C. B. asks what will remove iodine from marble. A. Try strong aqua ammonia.

(24) A. B.—Laboulbène recommends for the preservation of insects in a fresh state plunging them in a preservative fluid consisting of alcohol with an excess of arsenious acid in fragments; 1½ pint alcohol will take about 14 troy grains of arsenic. The living insect, put into this preparation, absorbs about 3-1000 of its own weight. When soaked in this liquor and dried, it will be safe from the ravages of moths, *Anthrenus* or *Dermestes*. This liquid will not change the colors of blue, green or red beetles if dried after soaking from twelve to twenty-four hours. *Hemiptera* and *Orthoptera* can be treated in the same way. The nests, cocoons, and chrysalids of insects may be preserved from injury from other insects by being soaked in the arseniated alcohol, or dipped into benzine or a solution of carbolic acid or creosote.

(25) W. H. M. asks (1) whether methyl chloride is an article of commerce and whether it is expensive. A. No; it is a colorless gas at ordinary temperatures and pressure; it is condensable to a liquid at minus 22° C. To keep it in the liquid form it must be stored in very strong and hermetically sealed vessels. 2. Would it be necessary to produce pressure with the article, before evaporating, to produce a low temperature? If so, how much; if not, how low might the temperature be reduced by the use of an air pump to produce a vacuum and beginning at normal temperature and pressure? A. Exposed to the air it (the liquid) evaporates with great rapidity, its temperature falling below 0° F.; in vacuo this evaporation of course proceeds more rapidly than in air, and hence the reduction of temperature is greater. The greater the amount of liquid evaporated in a given time the lower the temperature attainable. 3. How large a quantity of methyl chloride should be used to produce appreciable results? A. Six ounces.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

C. W.—The substances you send for examination are as follows: 1 Red sandstone. 2. Calcite. 3. Hedenbergite. 4. Artificial. 5. Red granite. 6. Graphite in calcite. 7. Epidote. 8. Satin spar in dolomite. 9. Coccolite. 10. Dolomite. 11. Quartzite. 12. Hornblende. 13. Clinochlore. 14. Chlorite. 15. Natrolite. 16. Spodumene. 17. Calcite. 18. Iceland spar. 19. Limonite. 20. Decomposing feldspar.—O. E. C.—The sample is an impure Berlin blue containing alumina (from the alum used in its manufacture).—N. C.—The rock consists of serpentine, hornblende and quartz with copper and iron sulphurets (chalcopyrite and pyrite).—E. E.—The rock is a talcose slate. Some of it would doubtless answer very well for furnace linings if it can be worked economically.—H. S.—Amygdaloid trap, semi-decomposed—it contains opal quartz.—R. G. V.—No. 1 is rutile—titanic acid—oxygen 39, titanium 61—100. No. 2. Titaniferous sand, menneconite. No. 3. Ferruginous quartz containing crystals of rutile and iron pyrites, also probably gold.—W. K.—The quartz contains nothing of value.—G. W. K.—It is clear quartz rock. Useful for glass making.—O. B.—The iron ore is hematite of excellent quality.—J. C. M.—No. 1. Gypsum, lime sulphate. No. 2. Calcite, lime carbonate. No. 3. Malachite and azurite, carries traces of silver. No. 4 Contains clay, sand, and lime phosphate.—J. M. F.—It is the *mutilla occidentalis*, quite common in the Southern States.

COMMUNICATIONS RECEIVED.

On Ice Yachts. By J. E. K.

On Improvements in Telephones. By T. L. W.

On Measuring the Uneclipsed Portion of the Sun's Diameter. By L. L.

On a Curious Bone Formation. By E. L. W.

On the Great Wheat Belt of the United States. By J. W. B.

On Patent Temperance Reform. By L. J. F.

On New Motive Power. By W. M. M.

A Theory of the Tides. By W. B., Jr.

On Sailing Ice Boats. By H. R. B.

On Paraffine in Oil Wells. By D. F.

On the Velocity of Ice Boats. By P. F. S.

On Small Steamers. By J. A. W.

The Law of Dust Explosions. By A. D.

On the Speed of Ice Boats. By T. S. S.

On Making Copying Ink. By C. F. L.

On Explosion of Dynamite. By N. R.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

November 4, 1879,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city.

Ammonia and flute, combined, C. Bernhardt ... 221,148
Acid, making tartaric, H. Goldenberg ... 221,297
Aging and purifying liquors, apparatus for, Jacob & Lochner ... 221,316
Air compressor, W. Johnston ... 221,318
Animal trap, J. M. Hawkins ... 221,304
Animal trap, J. M. Keep ... 221,320
Animal trap, G. W. Lewthwaite ... 221,329
Anvil, horseshoe calk welding, E. J. Parker ... 221,183
Automatic gate, S. Small ... 221,268
Axle box, car, T. A. Bissell ... 221,278
Axle box, car, I. P. Wendell ... 221,259
Axles, die for making flap, C. H. Babcock ... 221,208
Bag and sack fastener, C. B. Elliott ... 221,292
Bag holder, M. Pomroy ... 221,251
Ball trap, W. C. Hinman ... 221,306
Basket cover fastening, W. I. Winne ... 221,208
Bed attachment, invalid, R. O'Donnell ... 221,346
Bed bottom, spring, S. H. Reeves ... 221,190
Bed or bed bottom, spring, E. A. Jeffery ... 221,317
Bedstead, wardrobe, F. R. Wolfinger ... 221,262
Beer cooler, J. S. Flautt ... 221,166
Belt fastener, T. O. Potter ... 221,353
Billiard cue chalk block, C. A. Fauts ... 221,164
Blacking box holder, H. Weston ... 221,260
Boot and shoe buffing machine, J. L. Copp ... 221,268
Boot and shoe lasting machine, C. H. Trask (r) ... 8,954
Boring machine, log, Bartlett & Evans ... 221,209
Boring machine, rock, W. W. Graham ... 221,298
Bottle stopper, L. Kutscher ... 221,324
Brick moulding die, D. O. Loy ... 221,243
Bridge, R. Long (r) ... 8,959
Bridle, M. R. Thurber ... 221,197
Brush cleaner, A. Hopfen ... 221,309
Buildings, construction of, F. Kaltwasser ... 221,319
Button and stud, E. A. Robinson ... 221,263
Button card, C. A. Righter ... 221,358
Button, separable, C. F. Quinley ... 221,189
Cabinet, toilet, F. C. Zanetti ... 221,383
Calculator, mechanical, S. Petty ... 221,186
Can, T. W. McNally ... 221,345
Can for hermetically sealed goods, C. C. Lane ... 221,325
Car brake, G. Smith ... 221,195
Car brake, automatic, O'Donnell & Dever ... 221,345
Car coupling, C. B. Santee ... 221,192
Car door, grain, M. F. Bagley ... 221,270
Car, freight, T. R. Hutton ... 221,315
Car propeller, N. A. Gaston ... 221,227
Car roof, railway, H. Aldridge ... 221,142
Cars, pipe coupling for railway, J. E. Chapin ... 221,154
Carriage brake, child's, A. McRonald ... 221,336
Cash register and indicator, J. & J. Ritty ... 221,360
Chain, ornamental, A. Horst ... 221,233
Cigar box lock, L. F. Mergott ... 221,177
Clock escapement, C. E. Lord ... 221,331
Clock movement, A. E. Hotchkiss ... 221,310
Clock pendulum, H. Camp ... 221,213
Clock, striking, D. W. Bradley ... 221,210
Clothes pounder, C. W. Robinson ... 221,362
Clothes wringer, S. A. Bailey ... 221,271
Cock, J. Dewrance ... 221,288
Coffee and tea, apparatus for preparing, J. M. Webb ... 221,376
Creaming can, J. S. Farley ... 221,293
Cultivator, J. Dierdorff ... 221,289
Demijohns and bottles, lock stopper for, H. R. Gillingham ... 221,228
Dental drill, A. Hartman (r) ... 8,958
Deodorizing and disinfecting, process and apparatus for, J. M. Hirsh ... 221,232
Draught equalizer, L. O. Brekke ... 221,280
Drawer support, J. C. Hirsch ... 221,307
Dust pan, G. H. Howe ... 221,312
Dyestuffs, preparation of, M. Wise ... 221,381
Earring, W. A. L. Miller ... 221,178
Electric machine, dynamo, G. Lecoq ... 221,327
Electro-magnetic machine, L. Drescher ... 221,291
Elevator bucket, W. G. Avery ... 221,207
Envelopes, cutting instrument for, I. W. England ... 221,163
Equalizer, three horse, R. Scott ... 221,367
Fence, barbed, E. M. Crandal ... 221,158
Fence wire, barbed, S. H. Gregg ... 221,300
Fibers, machine for cleaning and extracting, P. Sanchez ... 221,365
File and holder, paper, J. C. Moore ... 221,339
Filter, water, T. Tripp ... 221,198
Firearm lock, A. E. Barthel ... 221,145
Firearm, magazine, J. Lee ... 221,328
Firearm, revolving, A. E. Barthel ... 221,146
Firearm, revolving, A. Hyde ... 221,171
Fire escape, F. P. Mankin ... 221,333
Furnaces, the gases from coking coal, process and apparatus for utilizing in, L. Stevens ... 221,257
Gleaner and binder, E. W. Jenkins ... 221,235
Gold, etc., apparatus for concentrating and amalgamating, J. Patterson ... 221,330
Governor, steam engine, F. Fosdick ... 221,296
Grinding mill, J. Stevens ... 221,371
Hair spring stud, Monday & Doherty ... 221,180
Hame, sheet metal, J. S. Brown ... 221,211
Harness, C. H. Cooley ... 221,156
Harness makers' use, machine for, J. B. Underwood ... 221,373
Hat and cap, E. P. Hoyt ... 221,313
Hay carrier L. Y. Myers ... 221,342
Hay loader, W. & B. F. Bader ... 221,269
Hay rack, J. Boyd ... 221,279
Heating and cooking furnace, gas, H. Q. Hawley ... 221,169
Hides, machinery for stocking, unhairing, and softening, R. Middleton ... 221,246
Hinge, gate, J. A. Grove ... 221,301
Hinge, spring, W. Gilfillan ... 221,168
Hinge, stop, J. M. Dodge ... 221,290
Hoe, T. B. Lockwood ... 221,242
Honey box for beehives, C. H. Connolly ... 221,284
Hoop machine, R. H. Nogar ... 221,344
Horse power jack, A. Wissler ... 221,204
Horses' hoofs, moisture and pressure pad for, D. C. Baker ... 221,272
Horseshoe, J. K. Oneil ... 221,347
Hose nozzle, adjustable, G. C. Palmer ... 221,349
Howeling, crozing, and chamfering machine, H. W. King ... 221,172
Hub sand band, W. H. Stevens ... 221,256
Incubator, J. L. Campbell ... 221,214
Indicator, W. L. Brownell ... 221,212
Kettle, G. W. Fisher ... 221,294
King bolt, clip, L. Pents ... 221,184
Kneader, dough, J. W. & A. Ruger ... 221,364
Knit mittens, manufacturing, E. R. Pearson ... 221,351
Lamp, Aikman & Osborn ... 221,263
Latch, A. Wimmer ... 221,261
Lathe, turning, J. H. Howell ... 221,311
Leather, removing extractive matter from tanned, Plumer & Kerans ... 221,187
Letter package clasp, J. W. Ripley ... 221,359
Level, pendulum, I. S. Winter ... 221,380
Lid or cover for vessels, J. C. Boyle ... 221,150
Lifting jack for vehicles, L. Haverstick ... 221,230
Loom, J. W. Drummond (r) ... 8,953
Loom, circular, J. J. Greenough (r) ... 8,952
Loom drop shuttle boxes, mechanism for operating, L. J. Knowles ... 221,237, 221,238, 221,239, 221,240
Loom harness motion, O. W. Kenison ... 221,321
Loom shuttle spindle, O. P. Richardson ... 221,191
Loom temple, W. H. Burns (r) ... 8,956, 8,957
Lubricator, J. G. Barrington ... 221,274
Measuring liquids, automatic apparatus for, H. E. Marchand ... 221,338
Meat mincing machine, G. S. Oberdorf ... 221,250
Meats, curing, J. M. Reid ... 221,357
Metal, galvanizing, Wahl & Ettonhead ... 221,200
Metallic plates, manufacturing ornamented, W. M. Hedges ... 221,231
Mining drill, C. F. Wilkinson *et al* ... 221,378
Motor, F. M. Morgan ... 221,340
Musical instrument, mechanical, E. P. Needham ... 221,374
Neck band shaper, F. L. Volk ... 221,199
Nut lock, W. Gray ... 221,299
Optometer, Klein & Giering ... 221,323
Oven, J. Graig ... 221,157
Oyster feeder, J. Langrall ... 221,326
Packing for pistons, plungers, etc., J. G. Willard ... 221,202
Padlock, permutation, W. Walker ... 221,258
Paper bag, D. Appel ... 221,144
Paper bag, D. J. Ferry ... 221,165
Paper box, A. Matchett ... 221,244
Paper caps, etc., machine for making plaited, W. F. Hunt ... 221,314
Paper cutting machine, G. R. Clarke *et al* ... 221,216
Paper dishes, making, C. Ingersoll ... 221,234
Paper pulp, renewing worn screen plates for, M. S. Drake ... 221,221
Pipe and hose coupling, J. E. Chapin ... 221,153
Plaiting machine, J. H. Allison ... 221,264
Planter and fertilizer distributer, combined seed, N. Birdsall ... 221,276
Planter, corn, M. P. Brown ... 221,282
Planter, corn and cotton seed, Z. T. Lee ... 221,241
Pocketbook lock, F. F. Weiss ... 221,377
Pocket, safety, J. Colton ... 221,283
Portable engine, J. Allonas ... 221,265, 221,266
Printing, chromatic, J. Carson ... 221,215
Projectile for small arms, H. J. Nowlan ... 221,349
Pulp screen, revolving, W. L. Longley ... 221,330
Pump, W. Garvens ... 221,167
Pump, M. W. McCortney ... 221,335
Pump for compressing air and gas, S. L. Wiegand ... 221,201
Pump handle attachment, A. A. Lamb ... 221,174
Pumps, cylinder lining for, H. Epping ... 221,223
Railway signal, F. B. Aspinwall ... 221,267
Railway switch, H. D. Sprague ... 221,196
Razors, manufacture of, C. F. Pluemacher ... 221,352
Refrigerating apparatus, T. Elkins ... 221,222
Refrigerating apparatus, J. A. Whitney (r) ... 8,955
Refrigerator, H. M. Diggins ... 221,218
Rope clamping hook, J. Robertson ... 221,361
Sash balance, W. Milner ... 221,247
Sash, window, G. H. Padgett ... 221,182
Saw mill buffer, reciprocating, J. D. Wilson ... 221,379
Saw mill dog, J. Little ... 221,176
Saws, machine for making scroll, J. F. C. Rider ... 221,253
Scale beam, Bidwell & Linen ... 221,149
Scalloping machine, F. Hanson ... 221,303
Scraper, road, H. W. Ball ... 221,273
Sewing machine shuttle, Miller & Diehl ... 221,338
Shipping case and can, T. Allen ... 221,143
Shirt, T. M. & E. Denham ... 221,287
Smokestacks of locomotives, etc., cone for, F. A. Perry ... 221,185
Spooling machines, etc., thread guide for, J. E. Atwood ... 221,268
Station indicator, J. R. & W. J. Dearden ... 221,160
Steam engine, A. Ehret ... 221,224
Steel, manufacture of chrome, R. Brown ... 221,281
Stereotype plates, machine for shaving and trimming, W. Scott ... 221,366
Stopping and reversing mechanism for machinery, W. Scott ... 221,193
Stove, coal oil, J. M. Adams ... 221,206
Stove, heating, McCaw & Brown ... 221,334
Stove or furnace, W. P. Miller ... 221,179
Stove, vapor, F. Zugg ... 221,205
Strings from intestines, making, P. & J. Turner ... 221,199
Suspenders, L. & O. Oppenheimer ... 221,348
Tag fastener, W. T. Barron ... 221,275
Tanning, M. L. Doty ... 221,219
Tap for tin cans, etc., Cooper & Wagner ... 221,285
Telegraph lines, recorder for long, R. K. Boyle ... 221,151
Telegraph repeater, fire alarm, A. W. Gray ... 221,229
Telephone transmitter, C. A. Randall ... 221,355
Telephonic conductor, Holmes & Greenfield ... 221,170
Tenter clothing, Spitzli & Lacy ... 221,369
Thill coupling, W. S. Layard ... 221,175
Thill coupling, T. W. & H. K. Porter ... 221,188
Thill coupling and support, W. J. Morgan ... 221,341
Thrashing machine spikes, die for, F. Transue ... 221,372
Tongs, spring coal, C. M. Burgess ... 221,152
Toy gun, D. F. Hale ... 221,302
Traction engine, J. E. Praul ... 221,354
Trumpet for railway heads, P. C. Dawson ... 221,159
Tug link, H. J. Moreland ... 221,181
Universal joint coupling, J. Walker ... 221,375
Valve mechanism for direct acting engines, G. E. Dow ... 221,220
Valve, safety, F. B. Scovell ... 221,194
Vehicle shifting rail, J. L. Fisher ... 221,295
Vehicle, spring, J. J. Kraiss ... 221,173
Velocipede, R. Steel ... 221,255
Vise, F. C. Zanetti ... 221,382
Wagon brake, E. W. Pritchett ... 221,252
Wagon gear, E. P. Joslyn ... 221,236
Wash bench or stand, folding, M. S. Rawson ... 221,206
Watch case, Colby & Johnson ... 221,155
Water closet, hopper, J. Demarest ... 221,217
Water meter, piston, Barton & West ... 221,147
Water motor, W. F. Eyster ... 221,225
Wells, casing head cap for oil and other, W. R. Edelen ... 221,162
Wells, tubing clamp and elevator for oil, W. R. Edelen ... 221,161
Whip lashes, fastening, J. I. Fowler ... 221,226
Wind engine, J. Steiner ... 221,370
Windmill, Morrison & Tietjens ... 221,248
Window shade attachment, E. Metcalf ... 221,337
Window shade cloth, making, B. Birnbaum ... 221,277
Wire cloth, fastening for, M. Kennedy ... 221,322
Wire drawing machine, C. D. Rogers ... 221,254
Wood, compound for filling the pores of, T. G. Hojer ... 221,308
Wrench, W. A. Heath ... 221,305

TRADE MARKS.

Cigars, cigarettes, and smoking and chewing tobacco, S. Jacoby & Co ... 7,764
Cheese, F. Korbel & Bros ... 7,766
Chewing tobacco, T. C. Williams & Co ... 7,773
Chewing and smoking tobacco, I. S. Waters ... 7,772
Chewing and smoking plug tobacco, I. S. Waters ... 7,771
Fertilizer, J. Walker ... 7,770
Fertilizing compositions or compounds, B. W. L. Rasin & Co ... 7,765
Hair nets and other reticulated fabrics, A. G. Jennings ... 7,767
Vinegar, F. M. Bollman ... 7,768, 7,769

DESIGNS.

Breastpin or similar article of jewelry, H. S. Somes ... 11,495
Buckles, S. C. Hawkins ... 11,482
Carpet, T. S. Stearns ... 11,496
Font of printing types, J. K. Rogers ... 11,484
Grate fronts, F. S. Bissell ... 11,480
Group of statuary, J. Rogers ... 11,486
Handles of china and other vitrified ware, C. F. A. Hinrichs ... 11,483
Knit drawers, Swits Conde ... 11,488
Knit shirt, Swits Conde ... 11,485 and 11,489
Oil cloth, C. T. & V. E. Meyer ... 11,487 to 11,494
Watch chain ornaments, J. U. Gerow ... 11,481
Withdrawn ... 11,497

English Patents Issued to Americans.

From October 24 to October 28, inclusive.

Centrifugal machine, E. E. Quimby, Orange, N. J.
Coloring fibrous materials, H. W. Vaughan, Providence, R. I.
Drying apparatus, A. J. Reynolds, Chicago, Ill.
Grain elevator, W. Stoll, Brooklyn, N. Y.
Musical instruments, apparatus for playing, J. Y. Smith, Pittsburg, Pa.
Packing bottles, etc., E. Vorster, New Orleans, La.
Shroud block, O. E. Huss, Washington, D. C.
Stamp canceller, G. E. Emerson, San Francisco, Cal.

Advertisements.

Inside Page, each insertion ---75 cents a line.
Back Page, each insertion ---$1.00 a line.
(About eight words to a line.)

Engravings may head advertisements at the same rate per line, by measurement, as the letter press. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

☞ The publishers of this paper guarantee to advertisers a circulation of not less than 50,000 copies every weekly issue.

To Business Men.

The value of the SCIENTIFIC AMERICAN as an advertising medium cannot be overestimated. Its circulation is ten times greater than that of any similar journal now published. It goes into all the States and Territories, and is read in all the principal libraries and reading rooms of the world. A business man wants something more than to see his advertisement in a printed newspaper. He wants circulation If it is worth 25 cents per line to advertise in a paper of three thousand circulation, it is worth $4 per line to advertise in one of forty-eight thousand.

The circulation of the SCIENTIFIC AMERICAN is guaranteed to exceed FIFTY THOUSAND *every week*.

For advertising rates see top of first column of this page, or address

MUNN & CO., Publishers,
37 Park Row, New York.

NEW ROAD LOCOMOTIVES, BY Marshall, Sons & Co. General description and one engraving. SUPPLEMENT No. **56.** 10 cents.

CAVEATS, COPYRIGHTS, LABEL REGISTRATION, ETC.

Messrs. Munn & Co., in connection with the publication of the SCIENTIFIC AMERICAN, continue to examine Improvements, and to act as Solicitors of Patents for Inventors.

In this line of business they have had OVER THIRTY YEARS' EXPERIENCE, and now have *unequaled facilities* for the Preparation of Patent Drawings, Specifications, and the Prosecution of Applications for Patents in the United States, Canada, and Foreign Countries. Messrs. Munn & Co. also attend to the preparation of Caveats, Registration of Labels, Copyrights for Books, Labels, Reissues, Assignments, and Reports on Infringements of Patents. All business intrusted to them is done with special care and promptness, on very moderate terms.

We send free of charge, on application, a pamphlet containing further information about Patents and how to procure them; directions concerning Labels, Copyrights, Designs, Patents, Appeals, Reissues, Infringements, Assignments, Rejected Cases, Hints on the Sale of Patents, etc.

Foreign Patents.—We also send, *free of charge*, a Synopsis of Foreign Patent Laws, showing the cost and method of securing patents in all the principal countries of the world. American inventors should bear in mind that, as a general rule, any invention that is valuable to the patentee in this country is worth equally as much in England and some other foreign countries. Five patents—embracing Canadian, English, German, French, and Belgian—will secure to an inventor the exclusive monopoly to his discovery among about ONE HUNDRED AND FIFTY MILLIONS of the most intelligent people in the world. The facilities of business and steam communication are such that patents can be obtained abroad by our citizens almost as easily as at home. The expense to apply for an English patent is $75; German, $100; French, $100; Belgian, $100; Canadian, $50.

Copies of Patents.—Persons desiring any patent issued from 1836 to November 26, 1867, can be supplied with official copies at reasonable cost, the price depending upon the extent of drawings and length of specifications.

Any patent issued since November 27, 1867, at which time the Patent Office commenced printing the drawings and specifications, may be had by remitting to this office $1.

A copy of the claims of any patent issued since 1836 will be furnished for $1.

When ordering copies, please to remit for the same as above, and state name of patentee, title of invention, and date of patent.

A pamphlet, containing full directions for obtaining United States patents sent free. A handsomely bound Reference Book, gilt edges, contains 140 pages and many engravings and tables important to every patentee and mechanic, and is a useful hand book of reference for everybody. Price 25 cents, mailed free.

Address

MUNN & CO.,
Publishers SCIENTIFIC AMERICAN,
37 Park Row, New York.

BRANCH OFFICE—Corner of F and 7th Streets, Washington, D. C.

CATALOGUE OF SOME OF THE VALUABLE PAPERS

CONTAINED IN THE

Scientific American Supplement.

To be had at the SCIENTIFIC AMERICAN Office, and of all Newsdealers. In ordering, please be particular to specify THE NUMBER of the Supplement that contains the paper desired.

These papers may be had at THE SCIENTIFIC AMERICAN Office, New York, or may be ordered through any Bookseller or Newsdealers. In ordering, please be particular to specify **the Number** of the Supplement that contains the paper desired. Promptly sent by mail to any part of the world. Price Ten Cents each Number.

Chemistry.

PROGRESS OF INDUSTRIAL CHEMISTRY.—By J. W. Mallet. A brief review, from the *American Chemical Journal*, of the most important changes in the industrial applications of chemistry within the last few years, grouped under the following headings: New Sources of Supply of long known Materials. New Processes. New Mechanical Appliances. New Means of Production. New Demands for Consumers. Disposition made of Waste Products. Changes in Labor Market. Legislation. Tariff, etc. Part I.—Fuel and Arrangements for the Artificial Production of Heat. Slag Wool. *Metallurgy.* Iron. Steel. Wrought Iron. Cast Iron. Remarkable Appliances. Part II.—*Metallurgy.* Nickel and Cobalt Zinc. Tin, Bismuth, Copper. Lead. Mercury. Silver, and the various processes for reducing it from its ores. Gold, and the processes for extracting it. Platinum. *Metallic Alloys.* Aluminum Bronze. Phosphor Bronze. Manganese Argentum or German Silver. Iridio-Platinum. *Electro-Metallurgy* and other alterations of Metallic Surfaces; a general account of the most recent and more novel industries of this sort. These valuable papers, full of the greatest interest to all manufacturers and technologists, are to be found in SCIENTIFIC AMERICAN SUPPLEMENT, **186, 188,** and **204.** Price 10 cents.

OUTLINES OF CHEMISTRY.—BY HENRY M. McIntire. The following elements are treated plainly and concisely, with their Atomic Weights, Formulæ, Tests, Important Compounds, Practical Uses, etc. Selenium, Tellurium, Phosphorus, Silicon, Boron, and their Compounds. The Metals: their Classification. Potassium, Sodium, Lithium, Rubidium, Cæsium, Ammonium, Barium, Strontium, Calcium, and their Compounds. Iron, Chromium, Manganese, Tin, Arsenic, Antimony, Bismuth, and their Compounds. Copper, Lead, Thallium, Mercury, Silver, Gold, Platinum, Palladium, Rhodium, Ruthenium, Osmium, Iridium, and their Compounds. Organic Chemistry. Ethyl Alcohol; Ether; Acetic, Oxalic, Tartaric and Citric Acids. Glycerin; Saccharine Bodies; Starch; Cellulose. SUPPLEMENTS **144, 145, 153, 158.** Price 10 cents each.

THE CHEMISTRY OF GAS MANUFACTURE. By A. Vernon Harcourt, F.R.S., one of the Metropolitan Gas Referees. An interesting and valuable paper, showing the Origin of Coal. How Coal was Formed. Greatest Depth for Coal. Changes in Coal by Heat. Oil from Coal. Gases from Coal. Other Substances Derived from Coal. Varieties of Coal. Coal Tar and its Remarkable Products. Naphtha. Benzol. Creosote. Anthracene Oil. Pitch Coke. How Aniline is produced. Mauve. Anthracene. SUPPLEMENT **72.** Price 10 cents.

ON A NEW CHEMICAL INDUSTRY.—By M. Camille Vincent. Description of a new and ingenious process by means of which the waste liquors from the still in the beet-sugar industry, which were formerly thrown away as useless, are now converted into two valuable commercial products—Ammonia and Chloride of Methyl, the latter used in the production of Methylated dye colors. With 2 engravings. SUPPLEMENT, No. **172.** Price 10 cents.

PRODUCTS OF COMBUSTION.—BY Thos. Wills, F.C.S. Lecture delivered before the British Association of Gas Managers. Heat a Mode of Motion. Spontaneous Combustion of Iron. Decay and Combustion Identical, and Same Amount of Heat Evolved in Each Case. Chemical Action and Spontaneous Combustion of Zinc-ethyl. Phosphorus set on Fire by Water. Combustion of Bisulphide of Carbon. Inflammability of Coal Gas. Curious Differences resulting from the manner of Firing Gun-cotton. Combustibles and Non-combustibles. Temperature Produced by the Blowpipe. Quantity of Air required for Combustion. Illuminating Fuels—Candles, Sperm Oil, Gas. Amount of Vitiation of the Air produced by Gas-burning and Respiration. Ventilation, and its Curious Dependence on Building Material. Enormous quantities of Air required for Coal Mines. Dangers from Organic Matter in Ventilated Rooms. Products of Gas-combustion, and Injury to Metals, Book-bindings, etc., by the Sulphurous Acid from Gas. SUPPLEMENTS **139, 140.** Price 10 cents each.

SUSPENSION, SOLUTION AND CHEMICAL Combination.—By Wm. Durham, F.R.S. Experiments on Suspension of Clay in Water, Clay in Acid Solutions, Clay in Salt Solutions, with Investigations with 12 other Solutions, resulting in Four Conclusions. SUPPLEMENT **116.** Price 10 cents.

ON THE CONSTITUTION OF MATTER in the Gaseous State. An important and valuable Contribution to Science. By Charles Adolphe Wurtz, Professor of Chemistry at the Ecole de Medecine, Paris. Being a lecture, with brilliant experiments, recently delivered by him at the Royal Institute before the Chemical Society, London. This lecture embodies the Most Recent and Accurate Information Concerning the Constitution of Matter, and shows the Most Important Advances Made in Chemistry. It explains the theory of Molecules and Atoms, and presents in clear and concise form a vast amount of information. Contained in SUPPLEMENT **156.** Price 10 cents.

PARAFFIN.—WHAT IT COMES FROM; Several Methods of Manufacture: How to obtain the Best Results; the Yield of Tar; Composition of Paraffin. SUPPLEMENT **119.** Price 10 cents.

SMALL LABORATORY FOR PHARMACEUTICAL and Chemical purposes.—By G. F. Schacht. A Compact, Convenient, and Economical Equipment for Working, with cost, and four engravings, showing arrangement in detail. SUPPLEMENT **99.** Price 10 cents.

Metallurgy.

STEEL—ITS MANUFACTURE AND Working.—Constitution, Qualities, Tempering, etc. With 14 illus. By D. Chernoff. A most interesting and valuable treatise, full of important information, embracing the latest contributions to the general knowledge of the subject. SUPPLEMENT **36** and **37.** Price 10 cents each.

MANUFACTURE OF BESSEMER STEEL and Steel Rails as pursued at the works of Messrs. Brown, Bayley & Dixon, Sheffield.—By C. B. Holland. A valuable and instructive paper. Read before the Iron and Steel Institute. With Five Illustrations: the Plant; the Cupolas, Converters, the Ingot Pit, Blowing Engines, Hydraulic Machinery, etc. Hot Blast; Mode of Working, Improved Manufacture of Steel Rails. SUPPLEMENT **124.** Price 10 cents.

THE FLOW OF METALS.—BY DAVID Townsend. Valuable experiments, with ten engs., on Punching through thick plates. Evidences of a Flow of Metal. Effect of Flow on Dimensions, Density, etc., of Plate. Lines of Least Resistance, etc. Punching with and across the grain. Practical applications. SUPPLEMENT **119.** Price 10 cents.

IRON AND STEEL—AN INAUGURAL address delivered before the Iron and Steel Institute by Edward Williams, concerning steel in bulk for railway requirements and constructive works. The subject is treated under the following headings: The Initial Processes; the Bessemer Discovery; Puddling; Improved Working; Steel and its Uses; is Remelting necessary? the New Steel-Making Process; Steel-Making Economies; the Future of Iron; Iron-Making Furnaces; American and other Foreign Competitions; Wasteful Ingot-Making; Better Rolling Machinery; Scientific Training needed; Unqualified Managers; Future prospects of Steel and Iron. Followed by a paper read at the same meeting by Geo. J. Snelus, on "The Removal of Phosphorus and Sulphur during the Bessemer and Siemens-Martin Processes of Steel Manufacture." Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **181.** Price 10 cents.

METALLIC MINERALS.—THEIR PRODUCTION and Uses. A lecture by J. G. Watson, F.R.S. A most interesting paper, containing much information on the principal metals; their ancient and modern uses; metallic veins; what they are, their courses in the earth; mineral leases and royalties; the famous Tavistock Mines; history of the Anglesea Mines; metals dissolved in water; how mineral veins are worked; iron and its uses; lead ores and uses of lead; tin ores and uses of tin; uses of copper. SUPPLEMENT **54.** Price 10 cents.

THE PROPERTIES OF IRON AND Steel.—By Daniel Adamson, C.E. Read before the Iron and Steel Institute, with 58 Figures and 2 Diagrams, being one of the most recent and valuable papers ever given to the public. How Testing Machines impose False Conditions. Endurance of Iron and Steel under Concussive Force. Thirty Experiments upon Plates. Annealed Steel. Effects of Sulphur, Phosphorus, and Cinder. Tensile Strength of Iron and Steel. Drilled and Punched Holes. Rule to Find the Power Required to Punch Steel Plates. The Ten-inch Test. Welding of Steel Boiler Plates. A thoroughly Practical and most Valuable Paper, giving Results of Numerous Tests on Bessemer Mild Steel, Best-best Boiler Plate, Martin-Siemens Steel, Crumble Steel, Sub-carbonized Steel, Swedish Bar Iron, Mild Rivet Steel, Best Merchant Iron, Tudhoe Crown Iron, etc., embracing 40 varieties of Iron and Steel. These Tests are illustrated by two full pages of cuts showing the Behavior of the Metal under Torsion, Tension, and Concussion, with the Effects of Punching. The Results embraced in one page of Tables, giving Size of Specimen, Permanent Set Induced, Maximum Strain per cent. of Elongation, Final Breaking Strain, Bending, Drifting before and after Annealing, Composition of Specimen, and all Particulars. Corrosion Tests. Concussion resisted best by Mild Steel. Corrosion of Iron *vs.* Steel by Sea Water. Steel for Ship-building. Best quality for Steel Rails. Best varieties for Gun Barrels. Injury done by Finishing at Black Heat by Hammering. Making Steel Fly Shafts, etc., and other Valuable Practical Conclusions. SUPPLEMENT **150.** Price 10 cents.

IRON AND STEEL.—BY DR. C. W. SIEMENS. An interesting and valuable paper, containing accounts of the most recent practical improvements in the Production, Working and Application of Iron and Steel; embracing the question of Labor in its relation to Capital; the Character, Value, Cost, and Production of the various kinds of Fuel, including Bituminous Coals, Coke, American Fuels, Peat, Natural Gas Fuel, Liquid Fuel, Solar Fuel. Motive Powers and their Transmission over long distances. Water Power; its Transmission by Steel Ropes; its Transmission by Electricity. Wind Power. Bessemer Steel History. Siemens and Martin Steel. The Regenerative Furnace. The Open Hearth System. The Use of Ferro-Manganese. Use of Chromium. Production of Mild Steel. Piping of Steel. The Applications of Steel. Iron and Steel Nomenclature. Wrought Iron. Mechanical Puddling. Bell's New Process. Wrought Iron Direct from the Ore. Methods of Protecting Iron and Steel from Rust. Ainslie's Method. Barff's Method. SUPPLEMENTS **70** and **71.** Price 10 cents each.

THE MANUFACTURE OF WROUGHT Iron Pipe.—Choice of Iron. Rolling. Bending the Sheets; Welding the Tube; Polishing and Smoothing the Pipe; Manufacture of Gas Pipe, with four figures. Contained in SUPPLEMENT **136.** Price 10 cents.

MELTING POINTS OF METALS AND other substances; New Method of Determining.—By Dr. Himly. A Simple and Exact Method. SUPPLEMENT **71.** Price 10 cents.

THE FLOW OF SOLIDS.—BY LEWIS S. Ware, C.E. Novel and Curious experiments. Cold metal caused to flow through orifices, and the laws governing such flow, with mathematical calculations, and 13 illustrations. SUPPLEMENT **82.** Price 10 cents.

BRIEF HISTORY OF BESSEMER STEEL. By Henry Bessemer. An exceedingly interesting sketch of the history of Bessemer steel, from the period of the great invention down to the present time, as given by Mr. Bessemer himself at a meeting of the Iron and Steel Institute, and wherein the celebrated inventor recalls some of the incidents connected with his first presentation of the discovery to the scientific world; such as the incredulity of those to whom he suggested the use of his steel for rails, etc. Concluding with a sketch of the history of the Bessemer steel as applied to ship-building. Illustrated with 6 engravings of the specimens that were exhibited by the author to illustrate his paper. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **183.**

THE TREATMENT OF IRON TO PREVENT CORROSION.—By Prof. Barff. An interesting paper detailing the theory and practice of oxidizing the surface of iron by means of superheated steam to prevent rusting. The author's method, which is herein described is justly considered one of the most valuable discoveries of the age. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **174** and **175.** To be had at this office, and of all newsdealers. Price 10 cents each, or 20 cents for the two.

STEEL.—PRESIDENTIAL ADDRESS BY J. Robinson, before Section G, British Association, August, 1879. An able review of the development of Steel during the last forty years in its mechanical and economic aspects, pointing out the various new processes that have been introduced in its production, and the new applications that have gradually been made of it in the industrial arts. Contained in SUPPLEMENT, No. **197.** Price 10 cents.

BLAST FURNACE SLAG.—AN INTEResting paper descriptive of the many new and important uses of the hitherto waste material known as Furnace Slag, and the methods of its preparation, including Slag Shingle, Slag Sand, Slag Bricks, Slag Stone, Slag Mortar and Cement, Slag Wool, Slag Glass, Slag Railway Sleepers, Slag Paving Blocks, etc. SUPPLEMENT **199.** Price 10 cents.

EXPERIMENTS ON ALLOYS OF SILver with Embrittling Metals.—By Alexander E. Outerbridge, Jr. Being a series of Experiments Conducted at the United States Mint, Philadelphia, on the Effects of Silver Alloyed with Arsenic, with Antimony, with Bismuth, with Lead. Interesting particulars of the results of each experiment. SUPPLEMENT **185.** Price 10 cents.

Civil Engineering.

STRONG AND CHEAP SPAR BRIDGES. Description, dimensions, and particulars, with 2 pages of drawings, covering illustrations of all the details, for a bridge of 100 feet span or less: specially useful for crossing of creeks, small rivers, gullies, or wherever a costly structure is not desirable. The drawings are from the Spar Bridge exhibited at the Centennial, in the U. S. Department of Military Engineering. These bridges are wholly composed of undressed stuff. SUPPLEMENT **71.** Price 10 cents.

LOUISVILLE RAILWAY BRIDGE OF the Cincinnati Southern R. R., over the Ohio river. 2 pages of engravings. SUPPLEMENT **55.** Price 10 cents.

THE NEW POINT SUSPENSION Bridge at Pittsburg, Pa.—By the Am. Bridge Co. With description and 8 figures. SUPPLEMENT **34.** Price 10 cents.

CARLISLE BRIDGE, DUBLIN; AND Foot Bridge over River Ness, at Inverness; both illustrated. Also WROUGHT IRON BRIDGE DESIGNS of improved construction. 2 illustrations. SUPPLEMENT **80.** Price 10 cents.

THE PROPOSED NEW IRON BRIDGE over the St. Lawrence River, at Montreal.—By Charles Legge, C.E. 5 engravings. SUPPLEMENT **13.** Price 10 cents.

THE VICTORIA BRIDGE (IRON), BRISbane, Queensland.—By Robinson and I'Anson. With description and 14 illustrations. SUPPLEMENT **10.** Price 10 cents.

GIRARD AVENUE BRIDGE.—A DEscription, with dimensions, working drawings, and perspectives of Girard Avenue Bridge, Phila., Pa. With foundations of piers. 10 engravings. SUPPLEMENTS **1, 2,** and **4.** Price 10 cents each.

THROSTLE NEST BRIDGE, MANCHESter, Eng.—A. Fowler, engineer. 10 elevations and perspective view. SUPPLEMENT **69.** Price 10 cents.

AMERICAN IRON BRIDGES.—A VALUable paper on iron bridge building. By T. C. Clarke, C.E. SUPPLEMENT **32.** Price 10 cents.

THE KENTUCKY RIVER BRIDGE.—Specifications, dimensions, with 8 illus. Also illustrated descriptions of the TAY BRIDGE, the POUGHKEEPSIE BRIDGE, the Lauria Floating Dock, and other Engineering Works. SUPPLEMENTS **66** and **95.** Price 10 cents each.

CLEOPATRA'S NEEDLE.—ITS REMOVal from Egypt to England. Details, with 9 engravings. SUPPLEMENT **69.** Price 10 cents.

THE UNITED STATES NEW IRON Landing Pier Del. Breakwater Harbor; built on iron screw piles. Designed by Lieut. Colonel J. D. Kurtz, U. S. Corps of Engineers. A full history, with map, description, details, and scale drawings. By A. Stierle, C.E., assistant engineer of the works. A valuable and important paper. With 42 illustrations. SUPPLEMENTS **72** and **73.** Price 10 cents each.

THE GREAT JETTY WORKS AT THE Mouth of the Mississippi River. A history of the work, with precise details of the construction, dimensions, method, etc. By E. D. Corteli, C.E., Chief Assistant Engineer of the Works. With 11 illustrations, including large chart of the South Pass and the Lines of the Jetties. SUPPLEMENT **21.** Price 10 cents.

DREDGING AND DITCHING MACHINery.—The latest and most successful machinery now in practical operation at Lake Fucino. With scale drawings and details, showing construction, operation, and economy. By M. A. Briesse, M.E. A most excellent and valuable paper upon the subject. SUPPLEMENT **8.** Price 10 cents.

AMERICAN BRIDGE ENGINEERING.—Compiled by G. S. Morrison, E. P. North, and J. Bogart, of the American Society of Civil Engineers. Containing particulars of the Illinois and St. Louis Bridge, designed by James B. Eads; the arrangement of the arches: form and dimensions of the spans; weight of iron in the structure; dimensions, and total cost. The Girard Avenue Bridge, Philadelphia, designed by Clarke, Reeves & Co.: description of trusses; the dead-load of the structure; the limit of strain on the parts; the kind of iron used; the floors, sidewalls, and roadways. Bridge at Port Jervis, New York, G. S. Morrison, Engineer, general description. Iron Railroad Bridge over the Ohio River, at Louisville, Kentucky, Albert Fink, Engineer: its length, and general description of the spans, with a statement of the quantity of iron in some of the principal spans. Rock Island Draw Bridge, designed and built by C. Shaler Smith, C. E., length and weight of the pivot span; description of the turn-table; how the span is rotated. Kentucky River Bridge, Cincinnati Southern Railroad, designed and built by C. Shaler Smith, C. E.; the peculiarities of its truss; the length of the girders: the piers and their pedestals. Bridge over Pennsylvania Railroad, at Forty-first Street, Philadelphia, Wilson Bros. & Co., Engineers; system employed in construction; general description; principal dimensions. Cincinnati Southern Railroad Bridge over the Ohio River at Cincinnati, built by Keystone Bridge Co.; dimensions; entire cost; description of trusses, floor, girders, etc. Point Bridge, Pittsburg, Penn., designed by Edward Hemberle, Engineer, general description; total length, and height above water. Short description of the Iron Derricks used by the Passaic Rolling Mill Company, of Paterson, N. J., in erection of the New York Elevated Railroad. SUPPLEMENT, No. **189.** Price 10 cents.

SEWAGE WORKS FOR SMALL TOWNS. —Designs made by Baldwin Latham, C.E., for the town of Skipton, England. 2 pages of illustrations, giving all the details of this most simple and effective system. SUPPLEMENT **75.** Price 10 cents.

THE SOUTH PASS JETTIES. BY MAX E. Schmidt, C.E. A paper read before the Convention of the American Society of Civil Engineers. Embracing a general description of works, together with abstracts of the plans and specifications of the works which were adopted for consolidating the Jetties; the constructions at the Sea end of the Jetties; comprising a full description of the novel mode adopted in the construction and deposition of the Concrete Blocks, the machinery and implements employed, the ingredients composing the Concrete and how mixed; accompanied by a table of Cement tests, etc. Illustrated with 17 engravings of machinery, sections, charts, plans, etc. Contained in SUPPLEMENT Nos. **200** and **201.** Price 10 cents each.

Mining.

DIAMONDS AND OTHER PRECIOUS STONES.—The Diamond Fields, Entertaining History of the Regent, the Koh-i-noor, and other famous stones. Sapphires, Rubies, Topazes, Emeralds, Beryl, Aquamarine, Cymophane, and Turquoise. Corundum, Rock Crystal, Amethyst. The remarkable ingenuity expended in producing false stones. Their Tests, etc. SUPPLEMENT **104.** Price 10 cents.

MINERS' LINGO.—A COLLECTION OF all the terms used by miners, accompanied by definitions of the same, as given by Mr. M. B. Carpenter in his New Mining Code. Indispensable to all those engaged directly or indirectly in the mining industry, or interested in mining stocks, and who desire to read accounts of mining operations understandingly. SUPPLEMENT, No. **181.**

ROCK-DRILLING MACHINES. BY JOHN Darlington. Tools, described and illustrated. Best Practice in Size of Holes, Kind of Explosive, etc. Machines and Tools, Air Pressure, etc., used at Mont Cenis, St. Gothard, Musconetcong, Maestog, Cwmbran, Port Skewet, Saarbruck, Ronchamp, Blanzy, Minera, and Ballnockish Tunnels, with three illustrations of Methods of Drilling. The Cut System, Brain's Radial, and other Systems. SUPPLEMENT **103.** Price 10 cents.

KIND-CHAUDRON PROCESS FOR SINKing and Tubing Mining Shafts. Read before American Institute of Mining Engineers. By Julien Deby, C.E. A valuable exhibit of the cost, methods, and tools employed, by 21 illustrations. SUPPLEMENT **82.** Price 10 cents.

CALIFORNIAN MINING STAMPS, MORtars, Dry and Wet, Sectional, and Wet Crushing Mortars for Gold and Silver. Cams, Tappets, Sockets, Shoes, Dies, etc. Guides, Screens, and all the apparatus carefully described, with Mode of Work, and Ten Illustrations. SUPPLEMENT **95.** Price 10 cents.

THE GREAT COMSTOCK LODE.—BY A. P. Schack, E.M., describing the geology of the region, qualities of ores, method of working; all of a highly interesting character; with many diagrams and sections, showing leads, shafts, and veins. SUPPLEMENT **73.** Price 10 cents.

TUNNELS AND ROCK-BORING MAchinery.—By John Darlington. Dimensions, and Methods employed in the Mont Cenis, St. Gothard, Hoosac, Sutro, Musconetcong, and Severn Tunnels, Rapidity of Work, Performances and Cost of Various Machines, Amount of Water, Compressed Air, etc., required, and nine illustrations. The Altenberg Zinc Mines, Aix-la-Chapello; Perseberg Mines, Sweden; Shaft at Salzberg. Altenwald; Marie Colliery; Pierre Dennis Pit; Stahlberg Musen, Prussia; Gouley Colliery; Dryrook Iron Mines; Sir Frances Level, Yorkshire; Frederichsegen Wrexem Mineral Mines; Johann Colliery, Prussia; Maestog Tunnel; Cymbran; Dolcoath; South Crofty, Cornwall; Carn Brea, Cornwall; Ballacorkish, Isle of Man. For each Mine or Tunnel is given the number of Holes in Heading. Character of Rock. Labor Employed, Time, Cost, etc. SUPPLEMENT **109.** Price 10 cents.

ROCK-BORING MACHINERY. — FROM the Work of R Schram. Comparative Merits of the several Systems; the Ram, the Lever, the Duplex, the Rotary, and the Direct-acting. The Burleigh, Sach, Warrington, Ferroux, Brandt, Osterkamp, Lisbeth, Reynolds, and other Machines, with Interesting Trials and Practical Experience with each. SUPPLEMENT **140.** Price 10 cents. Also, in same number, COMPRESSED AIR IN MINES. By M. G. Johnson. Its first use in the Mont Cenis Tunnel and Economy. Loss of Power by Loss of Heat; the Cold produced. High *vs.* Low Pressures. Description of the Kingswood Coal and Iron Company's Machines, with a Curious Circumstance.

HYDRAULIC MINING IN CALIFORnia.—By August J. Bowie, Jr. Four illus. Construction of Flumes. The Use of Wrought Iron Pipes. Table showing Details of Construction of Wrought Iron Pipe for the Spring Valley Water Company of San Francisco. Profile of Wrought Iron Pipe for the Cherokee Gravel Mines. Two Tables giving Thickness of Iron, Size and Distances of Rivets, and other particulars for various Sizes of Pipe. SUPPLEMENT **106.** Price 10 cents.

NEW HAND-LEVELS. ABNEY'S LEVEL for Prospecting, Computing Amount of Grading in Laying Out House Sites, Terraces, Drives, etc. Bohne's Automatic Level Description and Cost of each, with four figures. SUPPLEMENT **133.** Price 10 cents.

ROCK DRILLS WORKED BY COMpressed Air.—By H. W. Pendred, C.E. Description of the most recent and best practice. SUPPLEMENT **20.** Price 10 cents.

NEW METHOD OF BALANCING THE Winding Engines of the Deep Shafts of Westphalia.—By W. Fairley. A Simple, Practical Contrivance, with Description of Construction and Working, and three diagrams. SUPPLEMENT **117.**

Mechanical Engineering.

HARDENING AND TEMPERING OF Steel. By Joshua Rose. A valuable and excellent paper. What Steel is, and a comparison between Steel and Iron. How to temper to very Pale Yellow, Straw Yellow, Brown Yellow, Light Purple, Dark Purple, Clear and Pale Blue, Greenish Blue. To temper High Grades of Steel. Tempering in Milk and Water. The distinction between Hardening and Tempering. The Expansion and Distortion of Steel. The Weak Points. Decarbonization. Proper kind of Coke, etc. Clear Instructions that will insure success in every operation. SUPPLEMENTS **95, 103, 105.** Price 10 cents each.

FITTING KEYS AND KEYWAYS.—BY Joshua Rose SUPPLEMENT **56.** Price 10 cents.

CUTTING OUT KEYWAYS. BY JOSHUA Rose. An excellent practical description of the several methods employed, with eleven illustrations. The qualities of the various drills; square files and safe-edges, roughing out, etc. The best tools described and illustrated. SUPPLEMENT **79.** Price 10 cents.

MACHINES AND TOOLS FOR WORKING Metal, Wood, and Stone, at the Centennial Exhibition.—By John Anderson. Machines and Tools of the American Watch Company, Ames & Co., Pratt & Whitney, the Putnam Company, Brown & Sharp, Mr. Corliss, W. Sellers & Co., and others. The Corliss Bevel Gear Cutter; Sellers & Co.'s Steam Hammer; A New Machine for Making Plane Surfaces; Lathes; Planing Machines; Special Tools; an Automatic Gear Cutter; a Marked Change in Heavy Shearing Machines; Smithing and Forging. SUPPLEMENT **114.** Price 10 cents.

DIFFERENTIAL WHEELS OF NEW Form. By Prof. C. W. MacCord. The Action of Epicyclic Trains Explained, with five figures. Contained in SUPPLEMENT **134.** Price 10 cents.

NEW FORM OF TOOTHED GEARING. By Prof. C.W. MacCord. Elliptical Bevel Wheels. An Interesting Mathematical Application and Entertaining Mechanical Study. With Five Figures and Directions for Draughting. SUPPLEMENT **141.** Price 10 cents.

THE EFFECT OF PUNCHING OF IRON and Steel Plates.—By A. C. Kirk. Read before the Institution of Naval Architects. The Weakening Effects of Punching *vs.* Drilling in Riveting. Experiments with Six Tables for Iron and Steel, giving Strain brought to bear, Elongation, and all particulars of the effects of Punching and Drilling, and six illustrations; also Hardening and Tempering of Steel, by Joshua Rose. SUPPLEMENT **95.** Price 10 cents.

These papers may be had at THE SCIENTIFIC AMERICAN Office, New York, or may be ordered through any Bookseller or Newsdealers. In ordering, please be particular to specify **the Number** of the Supplement that contains the paper desired. Promptly sent by mail to any part of the world. Price Ten Cents each Number.

Mechanical Engineering.

FILES *VS.* EMERY WHEELS AND MILLing Tools.—By Joshua Rose. Excellent practical suggestions on proper use of the Emery Wheel Milling Tools.—By Joshua Rose. Excellent practical suggestions on proper use of the Emery Wheel, Milling Tools, Buff Wheel, Files, etc., and Grades and Character of work to which each should be applied. Best Methods for Hard Metal Work, Saw Filing, Roughing Down, Trimming of Castings, Cylindrical Work, etc. SUPPLEMENT **63.** Price 10 cents.

CUTTING TOOLS FOR LATHES AND Planers.—By Joshua Rose. With nine figures. A valuable paper full of practical information. SUPPLEMENT **38.** Price 10 cents.

SURFACE PLATES OR PLANOMETERS, and Scraped Surfaces. A valuable treatise for mechanics who desire to execute truthful work. By Joshua Rose. With seven engravings. SUPPLEMENT **15.** 10 cents.

A FLY-WHEEL ACCIDENT.—WITH drawings, showing the faulty construction of the fly-wheel, the reasons for the breakage; with practical directions for the avoidance of such occurrence. By Joshua Rose. SUPPLEMENT **30.** Price 10 cents.

FRICTION. A SERIES OF EXPERIments on Friction, proving the falsity of the former formulas thereon, and giving others in accordance with actual results. By Prof. A. S. Kimball. SUPPLEMENT **76.** Price 10 cents.

ELLIPTICAL GEARING.—BY PROF. C. W. MacCord, of the Stevens Institute of Technology. With eight engravings. A most clear and excellent exposition of the subject. SUPPLEMENT **2.** Price 10 cents.

BAVILLE'S TOOL HOLDERS. — TOOL Holder for Lathe. Simple Tool Holder for Planing Machine. Double Tool Holder for Planing Machine. Shaping Machine Head. Simple Tool Holder, with Vertical Cutter, for Slotting Machine. Double Tool Holder, with Horizontal Cutters, for Slotting Machine. With 22 figures. SUPPLEMENT **147.** Price 10 cents.

STONE-SAWING MACHINERY. — A valuable and interesting paper, read before the Society of Engineers, with twenty illustrations. SUPPLEMENT **54.** Price 10 cents.

MILLING MACHINES AND MILLING Tools.—An excellent practical treatise. By Joshua Rose. Seven engravings. SUPPLEMENT **16.** Price 10 cents.

SKEW-BEVEL WHEELS.—BY PROF. C. A. MacCord. The subject of laying out the teeth of Skew-bevel wheels has been made, by the manner in which it has been hitherto treated, to seem more complicated than it really is. By a careful study of this article, wherein the author treats in a plain and practical manner of "Pitch-Surfaces and how to Draw Them, Tooth-Surfaces and how to Construct them, and Special and Singular Relations of Pitch-Surfaces." Any ordinarily expert draughtsman will be enabled to construct the wheels and their teeth in a manner which will satisfy all the requirements of practice. The principles involved in the mode of operation here described are demonstrably correct throughout, and the degree of accuracy attainable in the results will depend wholly on the care and skill of the manipulator. Illustrated with 27 explanatory figures, and contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **174, 176,** and **178.**

HOW TO ADJUST LINE SHAFTING.—By Joshua Rose. A valuable, practical paper, illustrated with 8 figures, showing how, by a very simple plan, shafting may be accurately lined. SUPPLEMENT, No. **190.**

Steam Engines and Boilers.

BOILER TEST, MANCHESTER STEAM Users' Association. Series of highly important tests made by subjecting boilers to hydraulic pressure to the bursting point, and exhibiting the weakening effects of steam necks, manholes, etc. Twelve illustrations. SUPPLEMENT **74.** 10 cents.

ON THE PRIMING OF STEAM BOILERS. By Wm. Major, Engineer, Danish Navy. Read before Society of Engineers. Two figures. An Important Paper, explaining a new and probable theory of the cause of Priming; giving Experiments on the subject, and enumerating the advantages of substituting Petroleum for Tallow in Boilers, to prevent Priming. SUPPLEMENT **82.** 10 cents.

CORNISH PUMPING ENGINES OF THE Hull Water Works. Two pages of engravings, to scale. With description. SUPPLEMENT **17.** Price 10 cents. Valve gear and parallel motion of same engine, one page of engravings, to scale. SUPPLEMENT **23** Price 10 cents.

ASHWORTH'S COMPOUND ENGINE, with Variable Expansion Gear. With nine illustrations. SUPPLEMENT **28.** Price 10 cents.

MARINE ENGINE. BY CRAMP & SONS. Large engraving. SUPPLEMENT **30.** Price 10 cents.

PUMPING ENGINE OF THE LEHIGH Zinc Works. Two pages of engravings. SUPPLEMENT **32.** Price 10 cents.

STEAM BOILER ECONOMY. A SERIES of Important Experiments by the Societe Industrielle de Mulhouse, showing the comparative economy of various types of boiler. Seven illustrations. SUPPLEMENT **76.** 10 cents.

ENGINES OF THE "BRITANNIC," THE Fastest Ocean Steamer in the world. Two elevations of engines, four Indicator Diagrams, dimensions, etc SUPPLEMENT **51.** 10 cents.

ENGINE OF THE STEAMER HUDSON. 1 page of engravings. General description; also table of dimensions and performances of the single engine steamers Hudson, Knickerbocker, and New Orleans of the Cromwell line. SUPPLEMENT **61.** 10 cents.

ENGINES OF THE "LOUDOUN Castle," a Fast Ocean Steamer.—Three elevations, dimensions, and description. SUPPLEMENT **79.** 10 cents.

STATIONARY BOILERS. — OFFICIAL Tests at Centennial Exhibition. Description of Experiments on 15 Boilers of various kinds, and comparative tabular statement, giving pressure in Boiler, Temperature of Steam, Moisture of Steam, and amount of Superheating, Water Evaporated, Coal Consumed, Rating of Boiler, and many other particulars. Also Coal and Firing, percentage of Refuse, Calorimetric Observations, etc. SUPPLEMENT **89.** 10 cents.

GREAT CORLISS ENGINE AT THE CENtennial.—Dimensions and general description. With full page perspective engraving, and two pages of outline drawings made to scale. SUPPLEMENTS **19, 26, 36.** Each 10 cents.

WATER IN STEAM.—BY PALAMEDE Guzzi, C.E. Measurement of the Water Mechanically Suspended in Steam, with two figures. What has been done, with full description of a New Improved Apparatus. *Measurement of Water Mechanically Suspended in Steam.* By J. B. Knight. Description of Improved Apparatus, and Method of Operating. SUPPLEMENT **114.** Price 10 cents.

ON THE CAUSES OF KNOCKING IN high pressure engines.—By Joshua Rose. With nine engravings. A valuable practical treatise. Price 20 cents. SUPPLEMENTS **1** and **2.**

PLACING CRANKS ON SHAFTS AT Right Angles.—By Joshua Rose. With seven engravings. A valuable paper. SUPPLEMENT **23.** Price 10 cents.

HOW TO SET A SLIDE VALVE.—BY Joshua Rose. Seven engravings. The best practical treatise on the subject, giving in condensed form simple and plain directions, which will enable any person to Set Slide Valves quickly and correctly. SUPPLEMENT **13.** Price 10 cents.

THE SLIDE VALVE. BY SAME AUTHOR. In SUPPLEMENT **51.** Price 10 cents. A clear explanation of Lap, Lead, Clearance, etc. With eight illustrations of Valve Movements.

STEAM ENGINES AND BOILERS FOR High Pressures. By Loftus Perkins. Benefits of High Pressure, with practical plans and specifications of successful Engines and Boilers now in use, with Indicator Diagram. SUPPLEMENT **81.** 10 cents.

LIQUID FUELS.—BY H. AYDON. A paper read before the Institution of Civil Engineers, London. The five methods of burning liquid fuel, C. J. Richardson's, Simm and Barff's, Aydon's, and Dorsett's. Practical Working of each method, and comparative economy. SUPPLEMENT **119.** Price 10 cents.

THE MORRIS BLOWING ENGINE, with two pages of illustrations. SUPPLEMENT **39.** Price 10 cents.

Railway Engineering.

LOCOMOTIVES.—SPECIFICATIONS, Dimensions, etc., of the Tank Locomotives of the London, Chatham and Dover R. R.'s With three engravings. SUPPLEMENT **23.** Price 10 cents.

NARROW GAUGE SWEDISH LOCOMOtive, with a page of engravings. SUPPLEMENT **41.** Price 10 cents. Locomotives of the EIGHTEEN-INCH RAILWAY at Crewe, Eng. Two engravings. SUPPLEMENT **44.** 10 cents.

NARROW GAUGE LOCOMOTIVES. INdian State Railways, engraving and dimensions. SUPPLEMENT **53.** 10 cents.

EIGHTEEN OUTLINE FIGURES OF Locomotives exhibited at the Centennial, showing their measures, with a table of principal dimensions of each locomotive. SUPPLEMENT **35.** Price 10 cents.

BALDWIN LOCOMOTIVE.—LARGE ENgraving in sectional elevation, with measures, scale, and table of dimensions. SUPPLEMENT **38.** Price 10 cents.

NEW ROAD LOCOMOTIVES. — BY Marshall, Sons & Co. General description and one engraving. SUPPLEMENT **56.** Price 10 cents.

EXPRESS PASSENGER LOCOMOTIVES, Great Western R.R. With five engravings, and tables of all the principal dimensions. SUPPLEMENT **58.** Price 10 cents.

LOCOMOTIVE FOR BURNING PETROleum.—Used on Russian Railways. With description and five illustrations. SUPPLEMENT **63.** 10 cents.

RACK RAILWAY LOCOMOTIVE OF the Kahlenberd Railway near Vienna. Five elevations, and all particulars. SUPPLEMENT **70.** 10 cents.

FIRELESS AND HOT WATER LOCOmotives.—History of the inventions on this subject, giving Dates of Patents, etc. Description and Working of Apparatus, etc. SUPPLEMENT **111.** 10 cents

COMPRESSED AIR STREET RAILWAY Car.—Description, with engravings, dimensions, and particulars of the Mekarski Street Cars, now used in Paris, and propelled by compressed air. SUPPLEMENT **18.** 10 cents.

NEW RAILWAY LOCOMOTIVE CRANE, by Black, Hawthorne & Co. 4 engravings to scale, dimensions, etc. SUPPLEMENT **54.** 10 cents.

LOCOMOTIVE INJECTORS, WITH ENgraving. SUPPLEMENT **42.** The same number contains sectional elevation of locomotive for Dom Pedro Railway, with table of dimensions. 10 cents.

STEAM TROLLY OR CHAIR USED ON Oude Railway. Two engravings. SUPPLEMENT **63.** 10 cents.

LOCOMOTIVE CONNECTING AND Parallel or Coupling Rods. By Joshua Rose. With 10 illustrations. A practical and useful paper. SUPPLEMENT **31.** 10 cents.

STEAM STREET RAILWAY CARS. BY A. Brummer, M.E. Economical, no noise, effective. With working drawings of car, engine, boilers, dimensions, and full particulars. SUPPLEMENT **22.** 10 cents.

ENGLISH RAILWAY CAR COUPLINGS. A valuable treatise, showing the existing construction and the character of improvements wanted. With twenty engravings. SUPPLEMENT **21.** 10 cents.

STANDARD FREIGHT CARS OF THE New York Central and Hudson River R'ys. With working drawings and full specifications, showing dimensions and all particulars. Designed by Leander Garey, Supt. of Cars. With eight engravings. SUPPLEMENT **18.** 10 cents.

ELECTRO-MAGNETIC RAILW'Y BRAKE of M. Achard, now in Use on the Northern Railway of France. Description of a very successful system of Powerful Continuous Brakes. SUPPLEMENT **111.** Price 10 cents. In the same number is an Instructive Paper on Fireless and Hot Water Locomotives.

LOCOMOTIVES AT THE PARIS EXHIBItion.—Engines for the Western R.R. of France, built by MM. Ernest Gouin et Cie. Full Description and Dimensions, with Three Elevations and Two Sections to Scale. Contained in SUPPLEMENT **135.** Price 10 cents.

FIELD RAILWAY FOR RAPID CONstruction in War. By J. B. Fell. Experiments proving the possibility of Constructing a Railway as rapidly as an Army marches. How Grading is avoided. Freight transported. Cost per mile, and all particulars. In same SUPPLEMENT, descriptions and illustrations of the WESTINGHOUSE BRAKE and the OHIO RIVER VIADUCT. All contained in SUPPLEMENT **55.** Price 10 cents.

RAILWAY APPLIANCES AT THE Philadelphia Exhibition. A paper read before the Institution of Civil Engineers, London. By Douglass Galton, F.R.S. Showing the characteristic differences between American and European Railways, etc. Both of the above papers are contained in SUPPLEMENT **125.** Price 10 cents.

WIRE RAILWAY IN USE AT HAREwood Coal Mine, British Col. A Successful and Economical Construction; Grading avoided; 120 tons of coal per day carried 3 miles with 20 horse power Engine. One illustration. SUPPLEMENT **65.** Price 10 cents.

METHOD FOR SUBMARINE RAILWAY Tunnels of cast iron. Bishop's Plan. Dimensions, estimates, and full particulars. By Perry F. Nursey, C.E. With ten illustrations. SUPPLEMENT **20.** Price 10 cents.

RAYNOR'S PLANS FOR IRON SUBmarine Railway Tunnels. By George Raynor, C.E. With description and ten illustrations. SUPPLEMENT **24.** Price 10 cents.

IRON RAILWAY TIES AND SLEEPERS. By Charles Wood, C.E. 12 illustrations. The various Systems of Iron Sleepers; the Bowl, Pot, or Oval; the Longitudinal Wrought Iron; the Transverse Wrought Iron. Practical experience with each. Durability of Wrought Iron for Sleepers. Adjustment of Gauge or Curves. Spreading Out. The Barlow Combined Sleeper and Rail. Hilf's, Hoenegger's, and Thomnen's Systems. Serre's and Battig's Systems. McLellan's and Potel's Sleepers. Wood's Cross System. The several systems illustrated, with particulars of Ballasting, Spikes, Keys, Collars, Chairs, and Tools; Labor, First Cost, Repairs, Wear, Corrosion, etc. SUPPLEMENT **125.** Price 10 cents.

NARROW GAUGE RAILWAY.—THE Billerica and Bedford, Mass., Two-foot R.R. 4 illustrations. The Route, Grades, Cuts, Curves, Ties, Ballasting, Culverts, Bridges, and Rails. The Locomotives, with particulars, engravings, and dimensions. Particulars and Dimensions of other Rolling Stock. Equipment and Cost of Road. SUPPLEMENT **115.** Price 10 cents.

PASSENGER ENGINES OF MIDLAND Railway, with table of dimensions. 3 engravings. SUPPLEMENT **27.** Price 10 cents. The same number contains report of valuable information given before the Master Mechanics' Association, concerning Locomotives and Locomotive improvements.

RAILWAY VELOCIPEDES.—DESCRIPtion of two styles of Velocipedes for use on the track of railways, and one of which is employed for various purposes by the officials of several of the largest Western railroads. Two engravings. SUPPLEMENT, **178.**

FRANCQ'S FIRELESS LOCOMOTIVE.—Full page illustrations of a form of fireless engine now doing successful service on the railway between Rueil and Marly-le-Roy, showing the engine in perspective and in section, and its working parts in detail, accompanied by complete explanatory text. SUPPLEMENT, No. **174.**

Hydraulic Engineering.

TURBINE WATER WHEELS.—A REport of the Official Tests of Turbine Water Wheels made during the Centennial Exhibition of 1876. With thirty one illustrations. Embracing Drawings and Descriptions of the apparatus used for each test. The Instruments employed for determining the Power and Revolutions of each wheel. Engravings and descriptions showing the Construction of the wheels that exhibited the Greatest Efficiency. Table showing the Names of the Exhibitors of the several wheels tested. Date of each test. Diameter of wheel. Fraction of gate. Weight on the scale in pounds. Revolutions per minute. Horse Power of wheel. Head on wheel, in feet. Head on weir, in feet. Flow over weir. Head on weir due to leakage. Horse Power of the water used. Percentage of efficiency realized by each wheel. Together with other valuable and interesting particulars. SUPPLEMENTS **59** and **61.** Price 10 cents each.

THE HYDRAULIC RAM. HISTORY OF its invention. The latest improvements and working of the ram: most successful Dimensions, Valve Seats, etc. Fischer's Ram and others. SUPPLEMENT **111.** Price 10 cents.

WATER SUPPLY FOR TOWNS AND Villages.—By Clarence Delafield, C.E. A valuable report, showing the cost and merits of the various systems—Discussion of the Holly system, its merits and defects—The reservoir system, with pumps, cost and advantages—Results obtained and economy of use of various systems in different towns, with names and duty realized—Facts and figures to enable town committees to judge for themselves as to the system best suited for their wants—The best sources of water supply—Water-bearing rocks—Artesian wells, their feasibility, excellence, and cost of boring—Importance of pure water—How surface water is rendered impure—Cost of water pipes, from 2 to 12 inches diameter, for towns, including laying, all labor, materials, gates, joints, etc. Estimates of income, water-rates for supply of 1,000 buildings. Contained in SUPPLEMENT **27.** Price 10 cents.

HYDROSTATIC JOINT FOR GAS AND Water Mains.—A Lead Joint Calked by Hydrostatic Pressure. A Durable Tight Joint, Economically and Easily Made and Repaired, which will Yield to Deflection without Leakage. Two figures. SUPPLEMENT **109.** Price 10 cents.

Architecture and Building.

FOUNDATIONS.—FROM A VERY VALUable paper on the subject of American Engineering, as illustrated by the American Society of Civil Engineers at the recent Paris Exhibition. Compiled by a Committee of the Society, composed of Messrs. George S. Morrison, Edward P. North, and John Bogart. Foundation Work as practiced in America; its characteristics, and the features that distinguish it from European methods. The free use of Timber, Crib Work, Piles, Caissons, Coffer Dams, Screw Piles. The Cushing System. The Towers of the New York and Brooklyn Suspension Bridge. The Piers of the St. Louis Bridge. The St. Charles Bridge over the Missouri River. The Poughkeepsie Bridge over the Hudson River—the boldest example of timber foundation on record. Bridge Superstructure.—Notes on the Earlier styles of American Bridges. The Burr Bridge and the Towne Lattice. The MacCalum Truss. The Pratt Truss. Description of the Howe Truss. Introduction of Iron Bridges. The Squire Whipple Bridge The Fink and Bollman Trusses. The Whipple, Murphy, or Linville Trusses. The Post Truss. The peculiarities of American as compared with European iron bridges. Introduction of Iron Trestles. Smith's Trestle Bridges. Improvements that have taken place in the last ten years. Description of the old and new Viaducts of Portage, New York. The Passaic Draw Bridge; general dimensions, weights adopted for calculation, weight of iron in structure, and general description of the Bridge. Oak Orchard Viaduct; general dimensions, weight of iron in structure, and short description. The Rockville Bridge; a full description of the structure, including the weight of iron used therein and general dimensions. SUPPLEMENTS, **187** and **188.**

HOUSE DRAINS AND THEIR COMMON DEFECTS.—By Eliot C. Clarke, C.E., Principal Assistant Engineer in charge of the Improved Sewerage Work, Boston, Mass. With 34 illustrations. An important and Valuable Paper, showing the Essential Conditions for Efficient House Drainage; the proper sizes, forms, and best materials for drains; the evil results of making them too large; the proper inclination for drains; the best methods of making them tight; the right and the wrong methods of connecting drains with sewers, with engravings How leaks in drains occur and how detected. Descriptions of the most common defects in drains, with engravings. Together with many valuable suggestions and directions of great value to housekeepers and owners of property, whether in town or country. This paper is based on the observations of the author during an extended experience in the actual construction of drains and sewers, and presents in concise form the latest and best information on the subject. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **179.** Price 10 cents.

COMPACTED BEAMS, TABLING, INdenting, and other methods of Combining Beams, with other Suggestions for the Use of Wood in Works of Magnitude, and Useful Historical Examples. SUPPLEMENT **117.** Price 10 cents.

HEATING BY HOT WATER—A VALUable practical article.—By a Hot Water Engineer, fully explaining the natural principles which must be understood and kept in view by all engineers who wish to achieve success in this method of warming buildings; showing how to calculate and properly arrange the piping, and how to construct the supply cistern; describing the best form of boilers, how they should be made, and what they should be made of and how they should be set; and giving recipes for the best kinds of cements to be used in this department of engineering. Illustrated with 3 diagrams. SUPPLEMENT, No. **171.**

STREET PAVEMENTS AND SIDEWalks.—A description of the best kinds at present in use in various large cities of the United States, with the cost per square yard. By F. Shanly, C.E., City Engineer of Toronto. SUPPLEMENT **33.** Price 10 cents.

WARMING AND VENTILATION.—BY D. Galton, R.E. An exceedingly clear and Instructive paper. The Movements of Air in Buildings, and its Passage through Brick Walls, etc. Character of Poisonous Emanations, and How Detected. Cheap and Effective Ventilation, with Economy of Fuel, and no Draughts. SUPPLEMENT **94.** Price 10 cents.

THE VENTILATING AND WARMING of School Houses.—By Dr. F. Winsor. Tests of Purity of Air. True Philosophy of Ventilation. Experience in War Proving Importance of Pure Air. Removal of Germs and Stenches. Necessary Cubic Space, and Frequency of Renewal. Proper Humidity. With New School House Design. SUPPLEMENT **98.** Price 10 cents.

FIREPROOF CONSTRUCTION. — READ by F. Schumann, C.E., before the American Institute of Architects. With 16 Figures. Maximum Temperature of a Fire. Protection of Constructive Ironwork. Details of Construction of Brick Arches, Flat Hollow Tile Arches, and Corrugated Sheet-iron Arches. Protection of Lower Flange of Beams. Cast-iron Protected Columns. Slated Roofs, with Purlins, Bolts, and all Details. Flat Roofs Covered with Metal Sheets or Cement. Burnt Clay Tile Roof. Metal Box Roof. Ordinary Floors. SUPPLEMENTS **137, 139.** Price 10 cents each.

FIREPROOF DWELLINGS OF CHEAP Construction.—A valuable and important paper, containing Plans and Descriptions of Model Fireproof Dwellings of cheap construction lately erected in Chicago. By J. Smith, Architect. With 9 illustrations. Plan No. 1 exhibits the construction of comfortable one-story, 16 ft. front, dwellings, of brick and concrete, finished complete, at a cost of $1,200. Plan No. 2 exhibits the construction of a comfortable 23 ft. front, two-story dwelling, of brick and concrete, finished complete, with cellar, for $1,700. Several of these dwellings, on both plans, have been built at the prices stated. This valuable paper also contains the Report of the City Authorities of Chicago, certifying to the fireproof nature of these buildings, as determined by severe trials by fire, made in their presence, with other useful particulars. SUPPLEMENT **91.** Price 10 cents.

CURVILINEAR ROOFS.—AN IMPORtant and valuable paper, illustrated by 50 figures, exhibiting the forms of all the principal styles of curvilinear roofs now in use. Embracing the drawings of the roof of the great railway depot of the Northern of France, Paris. SUPPLEMENTS **40, 42.** Price 10 cents each.

SCHOOL HOUSE DESIGN. BY F. LANGdon, Architect. With Engraved Plan. Being a new and excellent design for villages and small cities; combining strength, beauty, and convenience. Also, an important and exhaustive paper on the Ventilation and Warming of School Houses. By Dr. F. Winsor. SUPPLEMENT **98.** Price 10 cents.

$150 SUMMER COTTAGE. BY S. B. REED, Architect. A Neat two room House for family of four. Dimensions, Cost of Materials and Labor, Six Plans and Elevations, and all Details of Construction, given in SUPPLEMENT **136,** with an illustrated description of an IMPROVED CONSTRUCTION FOR GREENHOUSES, CONSERVATORIES, etc. Price 10 cents.

HOW TO BUILD CONCRETE WALLS.—Practical directions how to build walls for barns, dwellings, and other purposes, by the concrete method, which is the most economical system in use. SUPPLEMENT **13.** Price 10 cents.

CONCRETE AS A BUILDING MATErial.—A Lecture delivered before the Royal Institute of Architects, London, by A. Payne, with discussion of the subject by prominent architects. This lecture and the extended discussions of the subject are contained in SUPPLEMENTS **26** and **34.** Price 10 cents each. They present a large amount of valuable information upon concrete building, in concise form.

CONCRETE BUILDING.—DESIGNS FOR cottages built of concrete, with elevations of the cottages and plans; also engravings of the apparatus, ingredients, method of mixing, preparing, and working the concrete, cost, etc. By Henry Macaulay, architect. With eleven illustrations. SUPPLEMENT **20.** Price 10 cents.

CONCRETE DOCKS OF NEW YORK.—With two engravings, showing the foundations of the docks, and the method of making the concrete blocks. SUPPLEMENT **23.** Price 10 cents.

CONCRETE FLOORS FOR BUILDINGS. By A. C. Ponton. A valuable article, containing information derived from actual experience in the use of concrete slabs for floors, with tests of strength, etc. SUPPLEMENT **36.** Price 10 cents.

The set of six numbers, containing the articles on concrete, sent for 60 cents.

BETON CONCRETE IN ARCHITECTure and Engineering, with 20 illustrations. Beton Bridge; Erie R. R. Portage Viaduct repaired with Beton; Beton Dwellings and Fountain, Brooklyn, N. Y.; Beton Church; Beton Culvert Lining, Erie R. R.; Beton Arches, Church Tracery, etc.; Beton-lined Railway Tunnels; Beton Pavements; Crushing Strength of Beton; Superior Strength of Beton Arches, etc. SUPPLEMENT **118.** Price 10 cents.

CONCRETE DWELLINGS.—READ BY B. H. Babbage before the Adelaide Philosophical Society. Details of a Successful and Instructive Experiment. A Dwelling constructed entirely of Lime Concrete—Walls, Roof, Staircases, and Arches fifteen feet in width. SUPPLEMENT **111.** Price 10 cents.

THE CEMENTS AT THE CENTENNIAL Exhibition. By Q. A. Gillmore, U. S. A. The Portland Cements and Their Tests, and four methods of Manufacture. The Natural Quick-setting Cements, etc.; Materials for Cements; Localities where Obtained; Specific Uses for the various Cements; A Large and Valuable Tabular Statement of the Crushing and Tensile Strength of each variety exhibited and Names of Exhibitors; Excellent articles on Concrete Construction and other Architectural and Engineering subjects. SUPPLEMENT **64.** Price 10 cents.

INCRUSTATIONS ON BRICK WALLS. By William Trautwine. The various causes: Bricks Burned with Coal Fires; Sulphate of Magnesia; Dampness; Effect of common Mortar. Remedies. Also Report of the Sub-committee, on the same subject, appointed by the University of Pennsylvania. SUPPLEMENT **123.** Price 10 cents.

FOOT-WALK PAVEMENTS.—A PAPER read before the Association of Municipal and Sanitary Engineers. By E. Buckingham, C.E. With Directions for Making the Best and Cheapest Walks of Cements and other materials. SUPPLEMENT **82.** Price 10 cents.

These papers may be had at THE SCIENTIFIC AMERICAN Office, New York, or may be ordered through any Bookseller or Newsdealers. In ordering, please be particular to specify **the Number** of the Supplement that contains the paper desired. Promptly sent by mail to any part of the world. Price Ten Cents each Number.

Architecture and Building.

IRON AS A BUILDING MATERIAL.—A comprehensive review, giving the objections to the Architectural Use of Iron, and its Advantages; How to Treat Iron Artistically; What a Fireproof Building is; Cast and Wrought Iron under Fire; Valuable Suggestions How to Use Iron in Fireproof Structures. SUPPLEMENT **71.** Price 10 cents.

NOMENCLATURE OF BUILDING Stones and Stone Masonry.—By James R. Croes, William E. Merrill, and Edgar B. Van Winkle. A paper read before the American Society of Civil Engineers. An exhaustive article on Stone Cutting and Masonry, various Methods of Dressing, and Tools employed, with 34 illustrations. Nineteen Tools, illustrated, with Dimensions and How to Make. Squared, Quarry-faced, Pitched-face, and Drafted Stones, Rubble, Cut, Pointed, and Crandalled Stones, etc. Axed or Pean Hammered and Patent Hammered Stones. Bush Hammered and Rubbed Stones. Diamond Panels, Rubbie, Squared Stone, Range, Random, and Ashlar Masonry. 34 illustrations in all, with practical instructions. SUPPLEMENT **113.** Price 10 cents.

THE MATHEMATICS OF CONSTRUCTION.—By R. G. Hatfield, Architect. The Graphical Representation of Strains; Valuable Formulæ; Rules, and their Application to the Construction of Floors, etc., with illustrated description of the Walker Art Gallery, Liverpool, and the Great Church of Batalha, Portugal. SUPPLEMENT **96.** Price 10 cents.

CHIMNEY CONSTRUCTION.—READ before the Civil and Mechanical Engineers' Society, London, by J. M. Bancroft.—Temperature of the Escaping Gases, and Best Dimensions for Chimneys. Directions for Foundations. Dimensions, Foundations, and Time of Building of the following Chimneys, with Cost and Number of Bricks required: Townsend chimney, Port Dundas; St. Rollox Chemical Works chimney, Glasgow; Dobson & Barlow's Machine Works chimney, Lancashire; Edinburgh Gas Works chimney; Wesenfield & Co.'s Chemical Factory chimney, Prussia; Edward Brooks & Sons' Fire Clay Works chimney, Huddersfield; Mitchell Bros.' chimney, Bradford; Cox Bros.' Camperdown Linen Works chimney, Dundee; Circular chimney, Adams' Soap Works, near Birmingham. How to Protect chimneys from Lightning; also Important Account of How a Chimney was Straightened. SUPPLEMENT **116.** Price 10 cents.

CONCRETE WALLS.—A PAPER CONtaining a hint worthy of being considered by every farmer, and designed to dispel some of the erroneous notions that are held in regard to building side-hill barns. This essay shows how an old barn can be raised, and a good concrete wall placed under it so as to give as good a stable as if under a new barn. Gives plain and full directions how to raise the old barn, how to make the concrete, and how to build the wall. Demonstrates that the old side-hill plan is unnecessary. Tells how to build the drive-ways, and sums up the total cost. SUPPLEMENT, No. **183.**

HOUSE DRAINAGE.—VALUABLE DIrections for securing perfect drainage for dwellings, as issued by the Massachusetts State Board of Health; showing what size the drains should be, the proper slope to give them, and how they should be connected with the soil pipe and sewer; the importance of putting a plan to the work on record; the proper way to drain wet sites for houses; method of isolating sewers from houses by traps; the best arrangement for the soil pipe; how to trap water closets, sinks, basins, and bath tubs; the best patterns of water closets; how to detect gross defects in house drainage; how to dispose of sewage where there are no sewers. Illustrated with two cuts. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, **194.** Price 10 cents.

MASONRY AND BRICK-WORK.—BY J. Clark Jefferson. The Required Properties of Bricks. Properties of the clay sizes of Bricks in Germany and United States. Brickmaking, Mortars and Cements. Limes, fat and poor. Care and Slaking of Lime. Sand. The Chemical Change necessary to the Hardening of Mortar. SUPPLEMENT **148.** Price 10 cents.

EFFECT OF THE MOTION OF AIR within an Auditorium upon its Acoustic Qualities. By W. W. Jacques. The researches detailed in this paper are entirely new to science. The author shows that in most cases where the acoustic properties of public halls are bad, that this is due, not to the arrangement and material of the walls, but to the condition of the air, and that to procure a proper propagation of sound, all air currents must be done away with. He then points out how the latter is to effected. SUPPLEMENT, No. **164.**

Naval Architecture, Marine Engineering, Navigation.

THEORY OF STREAM LINES IN RElation to the Resistance of Ships. By William Froude, C.E., F.R.S., President of the Mechanical Section, British Association. With 35 illustrations. A valuable and exhaustive treatise, containing a large amount of practical information concerning the flow of water, its power, the movements of bodies in water, etc. SUPPLEMENTS **3, 4, 5, 6, 8.** Price 10 cents each. 50 cents for the series.

WAVE LINES.—BY DR. J. COLLIS Browne. A Description of their Form, and How Ships Ought to be Constructed to Meet them. With an Illustration of Dr. Browne's Improved Yacht Kalafish, with an account of her Remarkable Performances, and thirteen figures. Contained in SUPPLEMENT **135.** Price 10 cents.

WAVE-MAKING RESISTANCE OF Ships. By same author. With 4 illustrations. SUPPLEMENT **74.** Price 10 cents.

WAVE-MOTION.—BY PROF. OSBORNE Reynolds, F.R.S. Read before the British Association. Laws of Wave-Motion, with examples and three illustrations. Interesting Analogy between Wave-Motion and Transmission of Light, Heat, Sound, etc. New Views on the subject, with Mathematical Demonstrations. SUPPLEMENT **96.** Price 10 cents.

STEEL TORPEDO BOATS.—DESCRIPtion and 5 Drawings of Boat 75 ft. long, weighing but 14 Tons. Engines, 250 h. p. Steam Pressure, 120 lbs. The Surface Condenser, Ventilation, the Torpedo Apparatus, and the Screw. Apparatus for Throwing Greek Fire. SUPPLEMENT **116.** Price 10 cents.

ACTION OF SCREW PROPELLERS.—By James Howden, Institution of Naval Architects. What has been done, and what remains to do, in increasing the efficiency of the propeller. True direction taken by the streams of water, with 9 illustrations. Centrifugal action on the water impossible. Improved attachment of Blade to Hub, etc. SUPPLEMENT **101.** Price 10 cents.

SCREW PROPELLERS, THEIR SHAFTS and Fittings.—By Hamilton W. Pendred, M.E. An able treatise, showing the present practice, its advantages and defects. With 25 figures. SUPPLEMENT **4.** Price 10 cents.

Small Steamboats.

STEAM YACHT LADY FRANKLIN.—Illustrations in section of hull and engine of a steam yacht of excellent performance, economical in fuel, length 48 ft., double engine, cylinder 6¼ in. diameter and 8 in. stroke; boiler vertical, ¾ in. iron, diameter 38 in. With two engravings. Contained in SUPPLEMENT, No. **171.** 10 cents.

TWIN SCREW STEAM LAUNCH.—Illustrations in perspective and section, and description of a Screw Steam Launch built for passenger service in shallow waters in the East Indies. Boat propelled by twin screws; dimensions 56 ft. long, 7½ ft. beam, and 3 ft. 9 in. deep; draught 2 ft. 9 in. SUPPLEMENT, No. **171.**

LIGHT DRAUGHT STERN-WHEEL Steamer, built for the Hudson Bay Company. Lightness and Economy of Construction. Dimensions, and two illustrations. SUPPLEMENT **108.** Price 10 cents.

THORNYCROFT'S SCREW PROPELler.—Used on the fastest small steam launches in the world. With two illustrations, and an account of Trials. SUPPLEMENT **77.** Price 10 cents. In the same number is a description and engraving of a Paddle Engine for light draught steamboats. The firing of boilers, etc.

SMALL STEAM TORPEDO BOATS.—BY Mr. Donaldson. Read before the United Service Institution. Engraving and Complete Description of the Steel Propeller "Lightning," 84 ft. long; speed 19 knots per hour. Also, other boats, their Engines and Armament. Their Remarkable Destructiveness proved by Trial. Valuable Experience in War, etc. SUPPLEMENT **79.** Price 10 cents.

SMALL STEAMBOATS AND YACHTS. The Black Hawk, 15 ft. 10 in. long; 4 ft. 9 in. beam; 3-bladed screw, 21 in. diameter; boiler 20 in. diameter, 32½ in. high; weight, 300 lbs.; piston, 4½ in.; stroke, 4 in.; 3 horse power; speed of boat, 6 to 7 miles an hour. Perspective and working drawings of this boat and machinery. SUPPLEMENT **14.** Price 10 cents.

The same number contains views of the fast steam yacht Continental. Length, 50 ft., 6¼ ft. beam; 3½ ft. depth; two 6 in. cylinders, 6 in. diameter, 8 in. stroke; 74 horse power; speed, 17·9 miles per hour.

A Thirty-foot Steam Launch.—Approximate cost for boat and machinery complete, $380. Length, 30 ft.; beam, 6½ ft.; depth, 3 ft.; boiler, 3x4 ft.; cylinders, 4 in.; stroke, 6 in.; 3-bladed propelier, 2¼ feet diameter. General directions for construction are given. With 5 drawings. SUPPLEMENT **69.** Price 10 cents.

A Forty-foot Steam Launch.—With three-cylinder engine. Drawings to scale, dimensions, and general description. SUPPLEMENT **75.** Price 10 cents.

A Remarkably Fast and Small Steam Launch.—Designed by H. S. Maxim, M.E. Now running in New York Harbor. Length, 21 ft.; weight of boiler, 260 lbs.; engine, 75 lbs.; length of boiler, 28 in.; speed, 10 miles per hour. An elegant boat. With descriptions, dimensions, and drawings to scale. SUPPLEMENT **81.** Price 10 cents.

LIGHT DRAUGHT, FAST, STERN Wheel, steam Yachts. These yachts are 34 feet long, 8 feet 2 inches beam; draught, 16 inches; speed, 7 miles an hour. Designed under direction of Col. F. W. Farquhar, U. S. A., by M. Meigs, U. S. Civil Engineer, U. S. Works, Rock Island, Ill. With working drawings, dimensions, and particulars of vessel, engine, boiler, and wheel, furnished by the author. The serviceable character of these boats, their simplicity of construction, roominess, and light draught render them very desirable, especially for shallow waters. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **179.** Price 10 cents.

STEAM FOR SMALL BOATS.—REports of Trials of Steam Yachts, giving description of engines, and their management, proportion of boat, engine, and screw, and other valuable facts. With Engravings. SUPPLEMENT **158.** Price 10 cents.

Row Boats, Sail Boats, Etc.

HOW TO BUILD BOATS CHEAPLY.—A series of plain, practical articles, showing how any intelligent person, by following the directions, may build a boat with economy. Each article is accompanied by drawings, diagrams, directions, dimensions, etc.

The Three-Dollar Scow.—Directions for construction, seven illustrations. SUPPLEMENT **25.** Price 10 cents.

The Five-Dollar Rowing Skiff.—With full directions for construction. Thirteen illustrations. SUPPLEMENT **26.** Price 10 cents.

The Fourteen-Dollar Sailing Skiff.—With fourteen illustrations. Full directions for construction of boat, center board, rudder, mast, sail, etc. SUPPLEMENT **29.** Price 10 cents.

The Twelve-Dollar Row Boat.—Twenty-five illustrations. Illustrates the construction of a graceful ribbed boat, light weight. Shows the method of securing good lines, how to bend and arrange the ribs, dimensions of all the parts, and directions for construction in full. SUPPLEMENTS **30, 32.** Price 10 cents each—20 cents for the two.

The Sixteen-Dollar Family Boat.—With seven illustrations. Tables of measures and full directions for construction. A handsome and commodious boat. SUPPLEMENT **36.** Price 10 cents.

The Fifteen-Dollar Whitehall Row Boat.—With three illustrations. Tables of measures and full directions for construction. SUPPLEMENT **37.** Price 10 cents. This number also contains fourteen excellent practical rules for the management of sail boats, by an experienced sailor.

The Fifteen-Dollar Sailing and Rowing Canoe.—With eight illustrations, including perspective of double sale rig. Tables of dimensions and directions in full for construction. SUPPLEMENT **39.** Price 10 cents.

A Thirty-Dollar Yacht.—With eight illustrations, including perspective of sail rig. Tables of dimensions and full directions for construction. SUPPLEMENT **42.** Price 10 cents.

A Three-Hundred-Dollar Center-board Yacht.—With ten illustrations, dimensions, and directions for construction. A fast and serviceable vessel. SUPPLEMENT **67.** Price 10 cents. The entire series of 10 numbers, relating to boat building, sent for $1.

The series embraces about 100 illustrations.

SAILBOAT WITH ROLLER CENTERboard and Hinged Mast, three figures. Contained in SUPPLEMENT **134.** Price 10 cents.

NEW CAT-RIG. BY CAPT. R. B. FORBES. A Simple, Handy Sail that can be Reefed from the Standing-room in less than One Minute. Adapted to Cat, Sloop, and Schooner Rigs. Two figures. SUPPLEMENT **133.** Price 10 cents.

BOATS' RIGS.—NINE VARIETIES OF Rigs in Actual Use, for Yawls and Open Boats and Yachts. The Handiest Rigs for Cruising. The English Style. Nine figures. Also, Description with Dimensions and Four Drawings to Scale of a SMALL BOAT FOR ROUGH WATER, with Construction and Mode of Rigging. SUPPLEMENT **131.** Price 10 cents.

CATAMARAN, OR DOUBLE-HULLED Sailboat, with Malay Rig, in use in San Francisco Harbor. Directions for Constructing a Cheap, Simple and Handy Boat, with four figures. SUPPLEMENT **117.** Price 10 cents.

THE LIFE BOAT CANOE EVANGEList. A sailing canoe for Sea Cruising, with one illustration. SUPPLEMENT **112.** Price 10 cents.

HOW TO BUILD CATAMARANS, OR Double-hull Sailboats.—Combining simplicity of construction, safety, and high speed. Full directions for construction, dimensions, and illustrations of three sizes of these boats, costing from about $50 to $500. Also, interesting description of Mr. Herreshoff's Patent Catamarans. Speed 20 miles per hour. SUPPLEMENTS **105, 106.** Price 10 cents each.

FOLDING OR COLLAPSIBLE BOATS for Ships.—By Rev. E. L. Berthon, M.A. Read before Society of Arts. With three engravings, showing construction, with full description. SUPPLEMENT **84.** Price 10 cents.

SHARPIE MODEL SAIL BOAT.—BY E. A. Van and F. W. Tuttle. Working plans and description of a sail boat after the "Sharpie" model—a form of boat which for speed and seagoing qualities has no equal. With the aid of the drawings and directions here given almost any one with a few tools, and at small expense, can build a really good sail boat or steam yacht on this plan, giving much more room for machinery and crew than the more costly "Carver" or "Clinker" built boats of like dimensions. SUPPLEMENT, No. **177.**

THE CRUISING CANOE "JERSEY Blue." By W. P. Stephens, Commodore of the Jersey Blue Canoe Club. Full description, with engravings, of the best form as yet devised of a canoe for general cruising purposes. The boat here described was built after several cruises in a Rob Roy and "American Model" Nautilus, and the changes that have been made from the established form are such as the large experience of the builder has shown to be needed. By the aid of the minute instructions here given, and the accompanying 8 figures, which are drawn to a scale, this craft may be easily constructed. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **164.** Price 10 cents.

A NOVEL BOAT RIG.—BY H. R. TAYlor. Practical directions for rigging a small sailing craft in such a way that the sails are under the complete control of the helmsman, being quickly lowered in case of danger, and as quickly raised again, with a single hand, while the other is upon the tiller. By the aid of the author's description and the accompanying detail figures any one can fit his boat up with this peculiar rig and thereafter avoid all the danger that accompanies sailing in small vessels rigged in the ordinary style. Illustrated with 8 engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **163.** Price 10 cents.

BOAT LINES. HOW TO GET THEM.—By R. Gooper. Practical Directions, both for Designing and Building, with 11 figures. SUPPLEMENT **140.** Price 10 cents.

Ice Boats.

ICE-BOATS—THEIR CONSTRUCTION and management. With working drawings, details, and directions in full. Four engravings, showing mode of construction. Views of the two fastest ice-sailing boats used on the Hudson river in winter. By H. A. Horsfall, M.E. SUPPLEMENT **1.** The same number also contains the rules and regulations for the formation of ice-boat clubs, the sailing and management of ice-boats. Price 10 cents.

ICE-BOAT WHIFF.—FULL WORKING drawings and description, with dimensions of the model ice-yacht Whiff, the fastest yacht in the world. Exhibited at the Centennial, by Irving Grinnell. With 14 illustrations. SUPPLEMENT **63.** Price 10 cents.

Pneumatics.

COMPRESSED AIR MOTORS. BY GEN. H. Haupt, C.E. Being a Report to the Pneumatic Tramway Engine Co. of New York, concerning the use of Compressed Air as a Motor for propelling Street Railway Cars. Exhibiting the feasibility of the system and the Practical Success obtained as evinced by trials of the Pneumatic Cars and Compressors on the Second Avenue Railway, New York City. With a general description of the Air Compressors, the percentages of Power Realized out of the Power Consumed in pressing the air; the extent of the air compression and how used in connection with heat in the car; the cost per mile; the distance traveled by the Pneumatic Motor; increase of power by using the cylinders as air pumps; heat and cold by compression and expansion; what grades the Pneumatic Motor can overcome and what load it can carry; theoretical test of compressors; capacity of the Second Avenue compressors; effects of using a compression of fifty atmospheres; advantages and objections to use of pneumatic motors; moral and sanitary influences; estimate of the cost of power by the use of the pneumatic system as compared with horses; cost of operating the pneumatic motors on the Second Avenue railway; tables showing the quantities of air consumed on each trip of the car, the reductions of pressure, etc., with many other interesting and valuable particulars, theoretical and practical. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **176, 177,** and **182.** Price 10 cents

COMPRESSED AIR PNEUMATIC DISpatch System used in Paris. With description and 12 illustrative figures. SUPPLEMENT **24.** Price 10 cents.

NEW AIR COMPRESSOR OF M. DUBOIS, with description, dimensions. Illustrated by engravings. SUPPLEMENT **22.** Price 10 cents.

COMPRESSED AIR MOTIVE POWER.—With drawings and particulars of the most recent practice. The locomotives worked by compressed air in use in St. Gothard Tunnel Works, with dimensions, etc. Five engravings. SUPPLEMENTS **1** and **2.** Price 10 cents each.

GREAT BLOWING ENGINE, HIGH Speed and Novel Construction.—Built by Weimar Machine Works. An accurate description, giving performances, dimensions, new devices, and five elevations. This engine easily reaches 100 revolutions per minute, with a discharge of 5,000 cubic feet of air at 10 lbs. pressure. SUPPLEMENT **51.** 10 cents. Also, in same number, ROOT'S FORCE-BLAST BLOWERS, GAS EXHAUSTERS, AND BLACKSMITH'S TUYERES. 12 figures.

FORCE OF WIND. HOW TO ESTIMATE Required Strength of High Buildings, Towers Chimneys, and Spires. Formulas for Force of Wind at Various Velocities against Vertical Surfaces, and against Roofs at various Pitches; with three figures. SUPPLEMENT **109.** Price 10 cents.

NEW METHOD TO DETERMINE WIND'S Velocity, and to Test the Correctness of Anemometers.—By John H. Long. A Paper read before the Kansas Academy of Sciences. One Cut. SUPPLEMENT **110.** Price 10 cents.

Technology.

TOBACCO AT THE PARIS EXHIBITION. Valuable Details of Tobacco Culture; How to Raise a Good Burning Tobacco; How to Raise Mild or Strong Tobacco, as Required. Tobacco Culture and Statistics in Germany, Austria, Hungary, Belgium, France, Greece, Holland and Colonies, Italy, Spain and Colonies, Russia, Sweden, Roumania, Turkey, India, China, Japan, United States, and South America. Particulars of Snuff Manufactures, and the Manufacture and Flavoring of Chewing and Smoking Tobacco. The Most Approved Processes and Apparatus. The Automatic Torrifier, etc. The Manufacture of Cigars and Cigarrettes. Statistics of the Annual Consumption and Production of Tobacco, and the Revenues paid in the leading countries. Clear and Practical Information on every department of the Tobacco Trade. SUPPLEMENTS **133, 136.** Price 10 cents each.

THE SILKWORM.—A BRIEF MANUAL of Instructions for the Production of Silk. By Prof. C. N. Riley, explaining the Nature of the Silkworm; describing its Four different States of Egg, Larva, Chrysalis, and Imago; pointing out the Enemies and Diseases of the Insect; describing the Varieties or Races of the Silkworm; telling how the Eggs should be Wintered and Hatched, and the worms Fed and Reared; showing how the Worms prepare for Spinning, how the Cocoons should be Gathered, and how the Chrysalids should be Choked. Describing how the Reeling of the Silk is to be performed, and concluding with a Dissertation and the proper Food Plants for the Silkworm. Illustrated with 8 engravings. SUPPLEMENT, Nos. **174, 175.**

THE TECHNOLOGY OF THE PAPER Trade.—By William Arnot, F.R.S. Its Early History. Invention of the Beating Engine, Introduction of Soda, etc., and the First Machine-made Paper. Cameron's Machine; the Fourdrinier Machine. Interesting sketch of the Old Time Paper Mill vs. the Mill of Modern Times, the latter described at length, with all the Apparatus; the Sorting, Boiling, Breaking, Poaching, and Beating Processes; Progress of the Pulp through the Machine; the Draining, the Rolls, the Cooling Rolls, the Sizebath. Raw Fibrous Materials, their Characteristics and Treatment Preparatory to Pulping. Cotton, Straw, Linen, Hemp, Esparto, Wood. Instructive Account of the Numerous Chemical and Boiling Processes, etc. This treatise gives Practical Particulars in every Department of Papermaking, Describing the Latest and Best Processes and Machines in use, with Statistics, Profit, etc. SUPPLEMENTS **109, 110, 116, 117, 118, 123.** Price 10 cents each.

THE ART OF MARBLING ON PAPER.—By C. W. Woolnough. How it is done. What prevents the mingling of the colors. Kinds of mucilage used. Action of the Gall. Practical Directions. An operation beautiful in its simplicity, and instructive, as exhibiting the action of a natural law. SUPPLEMENT **119.** Price 10 cents.

THE MANUFACTURE OF GRAPE SUgar and Glucose.—By O. Luthy. Conversion, Neutralization, and Evaporation and Purification of the Liquor, Manufacture of Glucose by means of Malt. The Apparatus, Chemicals, and Practical Instructions for these Processes. SUPPLEMENT **96.** Price 10 cents.

BEET ROOT SUGAR MANUFACTURE. —By Edward L. Cull. A Method dispensing with Costly Outfit, and which may be tried with profit by Farmers. SUPPLEMENT **83.** Price 10 cents.

THE GRANULATION OF WHEAT.—BY Oscar Oexle, C.E. Treatment of Middlings. Practice in Austria, France, Italy, Spain, and other countries; Practice in High and Flat Grinding, Grading, Sizing, Purifying, etc. SUPPLEMENT **98.** Price 10 cents.

ON THE PREPARATION OF DEXtrine Maltose (malt sugar) and its Use in Brewing. By Wm. George Valentine, F.R.S., Professor of the Royal College of Chemistry. An exhaustive and able paper, containing the most recent and reliable information. SUPPLEMENTS **19, 22, 25, 28.** Price 10 cents.

MANUFACTURE OF ARTIFICIAL BUTter.—By Prof. Henry A. Mott, Jr., E.M. With six engravings. Being a History of the Artificial Butter Manufacture, Descriptions of the Principal Processes now in use, Details of Latest Improvements, Plan of an Artificial Butter Factory, Engravings of the Machinery required, Chemical Analyses of Butter and of Artificial Butter, Details of the Cost of setting up an Artificial Butter Factory, the Capital required, the materials and quantities consumed, Cost of Manufacture per pound, the Daily Profit, etc. A complete and reliable treatise. SUPPLEMENTS **48, 49.** Price 10 cents each.

PIPES FOR GAS AND OTHER PURposes. An excellent practical treatise, with 42 illustrations. The various kinds of pipes, chameroy, wood, paper, cement, and slate pipes; the numerous joints, ball and socket, harness, etc. The destructive power of various soils, and the most successful methods of preserving pipe. Extended directions on main laying, giving best practice. SUPPLEMENTS **62, 64, 66, 67, 68, 69, 72, 77.** Price 10 cents each.

DYEING RECIPES.—YELLOW CANnelle, Carmelite Olive, Tete de Negre, Dark Cannelle, Gold Yellow on Linen, Chrome Orange on Linen, Rose on Linen, Claret on Cotton Yarns, Fast Black on Woolen Yarn, Billiard Green on Cloth. Frothing of Colors. Dyeing, Printing, and Bleaching. New Sizing Method. Chinese Silk Production. SUPPLEMENT **53.** Price 10 cents.

SILVERING GLASS.—THE LATEST AND Best Method of Silvering Mirrors and other articles of Glass by Chapman's, Siemens', Petitjean's, Draper's, and Lavat's Processes. SUPPLEMENT **105.** Price 10 cents.

FREEZING MIXTURES.—THE SEVeral Methods of Lowering Temperature. Experiments. Tabular statement of Freezing Compounds and their relative Efficiency and Cost. By Prof. Meidinger. SUPPLEMENT **89.** Price 10 cents.

ICE MAKING AND ICE MACHINES.—By W. N. Hartley, F.R.S.E. Enumerating the several Processes. Carre's Ammonia Freezing Machine; the Sulphurous Acid Process used at the Chelsea Ice Rink, etc. The Laws of Cohesion and Heat. Sideley & Mackay's Process, and Description and Plans of their Factory in operation at Manchester, Eng. Particulars and dimensions of Apparatus, Quality, and Quantity of Ice produced, Cost, Profit, and other facts proving the Practical Success of this manufacture. SUPPLEMENTS **85, 91.** Price 20 cents for the two.

ON THE PRESERVATION OF WOOD. By J. Clark Jefferson, A.R.S.M. How to store timber. How to measure timber and judge of its quality. Causes and Prevention of Dry and Damp Rot. Durability and Preservation of timber in Mines. The three methods of Artificial Preservation: 1. Coating timber with Tar, etc. 2. Removing Sap by water or by steam. 3. Impregnating the wood by a solution of common salt, Sulphide of Barium, Sulphate of Zinc and Copper, etc. A valuable practical paper. SUPPLEMENT **119.** Price 10 cents.

LOGWOOD.—A LECTURE BY PROF. George Jarmain, showing the nature and extensive uses of this valuable dyeing material: the methods of its preparation; the chemical conditions of its coloring principles: the various colors it is capable of producing, together with the latest and best recipes for the practical use of the dye, embracing: common black at one operation; common doeskin black; doeskin black for wool; chrome black with blue reflection for wool; wooded blacks; lavender on wool; cudbear; archil and archil paste; logwood blue for wool; red woods; claret brown on wool; madder; brown on wool; how to test the value of dye woods. SUPPLEMENT **54.** Price 10 cents.

WOOL DYEING.—BY GEORGE JARmain. Lectures read before the Society of Arts, London. An excellent and complete description, embracing the following: The water required; impurities, and tests therefor; the influence of these aqueous impurities on scouring, rinsing, and dyeing; scouring materials; wool, cloth, and yarn scouring; wool bleaching; tinting or dyeing white, indigo, woad, madder, bran, lime, etc.; vats of various kinds, extracts of indigo, yellow colors, quercitron bark, ammoniacal cochineal, flavin, eosine, and many other dyes treated in full; fast and loose colors; fixation of color, mordants, lakes, alum, copperas, etc. SUPPLEMENTS **55, 74, 75, 76.** Price 10 cents each, 40 cents for the four.

These papers may be had at THE SCIENTIFIC AMERICAN Office, New York, or may be ordered through any Bookseller or Newsdealer. In ordering, please be particular to specify **the Number** of the Supplement that contains the paper desired. Promptly sent by mail to any part of the world. Price Ten Cents each Number.

Technology.

GLYCERINE IN WEAVING, DYEING, Printing, and Finishing. By M. H. Herberger. Glycerine as a Lubricant; Glycerine in Tanning; Glycerine as a Solvent of the Animal Dyes and other Colors; its Antiseptic Properties; Glycerine for Printing on Woolens; for Dissolving the Aniline Colors. Qualities of Glycerine required for various purposes. SUPPLEMENT **108.** Price 10 cents.

SYSTEMATIC EXERCISES. — THEIR Value in the Prevention of Disease.—By Edward T. Tibbits, M.D. A highly important and valuable paper. Read before the Leeds and West Riding Medico-Chirurgical Society. How much Exercise every one ought to Take. Much Disease a Result of Over-gratification of the Appetites. Cultivation of the Will a Cure for Bodily and Mental Ills. Criminal Negligence of Mothers. The Moral Influence of Bodily Exercises, and How they Aid in Controlling the Appetites and Passions. Contained in SUPPLEMENTS **150, 152.** Price 10 cents each.

JAPANESE LACQUER — ITS MANUfacture and application. With 19 illustrations. SUPPLEMENT **43.** Price 10 cents.

THE INOXIDATION OF IRON AND the Coating of Metals and other Surfaces with Platinum.—By L. M. Stoffel, C.E. A description of the processes of M. Dodé for the inoxidation of iron, the enameling of metals, and the platinum coating of metals. In these processes (to the application of which there is scarcely any limit in the industrial world) heat is substituted for galvanism, the use of acid is entirely dispensed with, and there is thus no cause to encourage oxidation. Compared with electroplating and galvanizing, Dodé's processes, by reason of their moderate cost and facility of application, present such advantageous features that a large field for operation is thereby opened. SUPPLEMENT, No. **177.** Price 10 cents.

HOW TO DO IT AND HOW NOT TO DO It. A series of sixteen engravings, being sketches from life, showing the Right and the Wrong Positions of working in executing various labors, such as Fine and Rough Chipping, Rough Filing, Draw Filing, Scraping, Boring, Grinding, Pattern Sawing, etc., etc. With many excellent practical hints. How to execute True Work, etc. SUPPLEMENT **88.** Price 10 cents.

HOW TO MAKE SPIRAL SPRINGS.— By Joshua Rose. With three engravings of the tools, which are easily made, and complete practical directions for working, including hardening and tempering. SUPPLEMENT **20.** Price 10 cents.

CASTING METALS, MEDALLIONS, Vases, and other articles in fusible alloys.—Full directions for home and shop practice, with engravings. By George M. Hopkins. SUPPLEMENT **17.** Price 10 cents.

SOLDERING.—AN EXCELLENT PRACtical treatise for home and shop use. By G. M. Hopkins. With eight illustrations. SUPPLEMENT **20.** Price 10 cents.

PRACTICAL DYEING RECIPES.—A collection of practical formulas which have all been verified as perfectly reliable, and which are warranted to come out satisfactorily if the proportions are adhered to, and the manipulations be workmanlike. Recipes for Blue or White Zephyr; Scotch Blue on Worsted—one Bath; Scotch Green on Worsted—one Bath; Jacquineaux on Worsted; Drab on Worsted—one Bath; Gold on Venetian Carpet Yarn—one Bath; Red Brown Slubbing; Scarlet Braid—One Bath; Slate Braid—one Bath; Light Drab on Cotton; Blue on Cotton; Brown on Cotton; Chrome Orange on Cotton Carpet Yarn; Black on Common Mixed Carpet Yarn for Filling; Black on Cotton and Wool Mixed Yarn. SUPPLEMENT, No. **169.**

ON THE MANUFACTURE OF Matches.—By John A. Garver, A.B. An exceedingly interesting paper. The Chemistry of the Match; Dangers of their Manufacture and use; Wax, Safety, and numerous curious varieties. Commercial Statistics. SUPPLEMENT **84.** Price 10 cents.

Photography.

PRINTING BY PHOTOGRAPHY.—BY Thomas Bolas, F. C. S. Lectures before the Society of Arts, London. Photo-lithography and Photo-zincography. Phototypic or Raised Printing Blocks, by Swelled Gelatine Process. Zinc Etching, and other methods. Line Engraving on Metal Plates. Printing of Half-tone Subjects from Metal. Application of Asser's Process. Talbot's Photo-engraving. Woodbury's Methods of Engraving and Printing. Collotype Printing. Other Methods of Producing Photos in Pigment. Dusting-on Process. Autotype Printing. SUPPLEMENTS, **143, 146.** Price 10 cents each.

PHOTOGRAPHS ON WOOD FOR ENgraving. By Edward Pocock. Practical Directions for Transferring Photos that will not Cut Up under the Graver. Also, a method of developing a Photo on Wood which may be Penciled on if desired, with instructions. SUPPLEMENT **53.** Price 10 cents.

PHOTOGRAPHIC PRINTINGS.—BY John L. Gihon. Items of information on every Class of Work, as Plain and Albumen, Porcelain and Carbon Printing. Paper for Printing, and its Preparation. The Sensitizing Bath. Printing and its results. Toning. Fixing the Image. Prints on Plain Paper. Permanent Pigment Printing. SUPPLEMENT **144.** Price 10 cents.

HOW TO USE PHOTOGRAPHIC BACKgrounds.—An address delivered before the Photographic Congress, Philadelphia, by L. W. Seavy. With 14 illustrations. A valuable paper, explaining the various methods of so using backgrounds as to produce the best effects, with examples of the wrong methods. Full of useful practical ideas for photographers. SUPPLEMENTS **48, 49.** Price 10 cents each.

PAPER NEGATIVES.—INSTRUCTIONS and Recipes for this Process. The Cyanotype Process, Coloring and Preserving Photos, etc. SUPPLEMENT **95.** Price 10 cents.

DRY PLATE PHOTOGRAPHY.— The Gelatine Process. A complete and practical description of the method of preparing the sensitive gelatine emulsion. By D. Van Monckhoven, the well known chemist and photographic discoverer. Being a report of his recent lecture before the members of the Belgian Photographic Association. These gelatine dry plates are more sensitive than the ordinary wet plates, and Dr. Van Monckhoven believes that the gelatine plates will sooner or later supersede wet plate photography and other forms of dry plate practice. The lecture embraces: (1) The Organization of the Dark Room. (2) The Nature of the Emulsion. (3) Preparation of the Gelatino-Bromide Emulsion. (4) Application of the Emulsion to the Glass. (5) The Preservation of the Prepared Plates. (6) The Exposure in the Camera. (7) Development of the Image. (8) The Pyro-development. (9) Fixing the Image. (10) Intensifying the Image. (11) Retouching and Varnishing. With two Illustrations. Contained in SUPPLEMENT **205.** Price 10 cents.

GELATINO-BROMIDE PLATES.—BY A. J. Jarman. A valuable paper, giving complete, practical directions by means of which any one can prepare plates for the gelatino-bromide process at home. The Apparatus to be procured. The Materials. How to make the Sensitized Emulsion. How to Prepare the Plates. How to Develop the Picture, and the Method of Intensifying a weak Negative. The method here given is sure, and easy to manage in the hands of any one possessing a small amount of knowledge of photographic manipulation, and will be found of the greatest value to those seeking accurate practical information on this subject. SUPPLEMENT, No. **190.** The same number contains an interesting article by Samuel Fry, entitled, *Reasons for Preferring Dry Plates to Wet Collodion*, in which the author puts forth a powerful plea in favor of the Dry Process, the result of long, practical experience.

PHOTO CHEMICALS; THEIR MANUfacture and Properties.—By John L. Gihon. Nitrate of Silver. Iodine, and the Iodides of Ammonium, Cadmium, Lithium, Potassium, Silver, Sodium, Zinc. Bromides of Ammonium, Cadmium, Potassium, Silver, Sodium. Chlorides of Sodium, Gold, Strontium. Pyroxylin, or Soluble Cotton. Alcohol, Sulphuric Ether, Acetic, Citric, Nitric, and Pyrogallic Acids, Protosalts of Iron. Hyposulphite of Soda, Cyanide of Potassium, Bichromate of Potash, Gelatine, Glycerine. Useful List of Chemicals needed by the Photographer. SUPPLEMENT **114.** Price 10 cents.

Electricity and Electrical Instruments.

TELEPHONE CALLS.—BY GEORGE M. Hopkins. Plain and complete practical directions for making an excellent although inexpensive signaling apparatus, working without a battery, and which, in the modified form here described, is so simplified that one bell and two magnets are dispensed with. Full directions also for making an alarm to be used with a battery and a closed circuit. By the aid of the minute descriptions, and the 6 scale drawings herein given, any one can construct a very efficient telephone call of either of the above kinds, which may be used in connection with any of the telephones employing permanent magnets, and which will answer well for rooms where the noise is not great. SUPPLEMENT, No. **162.** The same number contains a description (illustrated) of the Lorenz Telephone Call, and also a description (illustrated with 2 engravings) of the Call Bell and Morse Combination for telephone lines.

ELECTRIC LAMPS.—A COMPREHENsive paper embracing descriptions, illustrated with 33 engravings of all the principal electric lamps now in use, viz., The Brush Electric Lamp and the Brush Hanging Lamp, Wallace-Farmer Lamp, Maxim's Lamp, with and without gearing, and the regulating apparatus of the same. The Jablochkoff Candle, and the arrangement of the light apparatus. The Weston Lamp, the Serrin Lamp, Foucault's Lamp, Duboscq's Lamp, Archereau's Regulator, the Rapieff Electric Light in its various forms, the Regnier Electric Light, Reynier's Lamp, the Werdemann Electric Light, the Sawyer-Mann Electric Lamp, Fahrig's Burner, Directions for making a simple and effective Electric Lamp; Platinum Lamp, Figures illustrating carbon pencils as they appear under conditions varied by position and strength of current, Edison's Electric Light, and what is known of it up to the present time. SUPPLEMENT, No. **162.**

EXPERIMENTS WITH THE INDUCtion Coil. By George M. Hopkins. A description of many interesting and beautiful experiments which may be performed with the induction coil, and which exhibit the phenomena peculiar to the secondary current. Illustrated with 15 engravings. Experiments to show the Path of the Electric Spark over Mica; the Rotating Disk; Experiments with the Leyden Jar; the Fulminating Pane; the Gas Pistol; Stateham's Fuse; the Decomposition of Water, and the Apparatus for Effecting it; Geissler's Tubes; Geissler's Tubes showing Magnificent Striæ; Luminous Points shown by Bell Glass; Experiments with the Electric Egg; the apparatus for showing the beautiful experiment known as Gassiot's Cascade. SUPPLEMENT, No. **166.** Price 10 cents.

HOW TO MAKE A WORKING TELEphone.—By Geo. M. Hopkins. A valuable, practical paper, containing directions for construction of a cheap, simple Telephone. With Five Working Drawings, and View showing Line in Practical Operation. The Magnets, the Diaphragm, the Mouthpiece, and all parts clearly shown, with full Instructions How to Make the Magnets, size and arrangement of Wire, etc. Contained in SUPPLEMENT **142.** Price 10 cents.

THE HUGHES TELEPHONE. SIX FIGures. Sound converted into Undulatory Electrical Currents by Unhomogeneous Conducting Substances in Circuit. The Simplest Telephone and the most sensitive Acoustical Instrument yet constructed. Instrument for Testing the effect of Pressure on Various Substances. Interesting Experiments which may be performed by any person with a few nails, pieces of sealing wax, a glass tube containing powders, and a few sticks of charcoal. Contained in SUPPLEMENT **128.** Price 10 cents.

THE INDUCTION BALANCE AND SONometer.—By Geo. M. Hopkins. Plain directions for making the simple yet wonderful apparatus devised by Prof. Hughes, and called indifferently the "Sonometer" or "Audiometer." With these directions and the accompanying 6 figures in perspective and in detail, any one with a little mechanical ingenuity and at a trifling cost can construct for himself an instrument that will yield him a world of interest and amusement. SUPPLEMENT, No. **196.**

SMALL ELECTRIC LIGHTS FROM BATteries. An article showing the cost of the production of the Electric Light by the use of various batteries, as the Faure, Thomson, Bichromate of Potash, De Gourant De Tromelin, and Rotary, and demonstrating, from the expense thus ascertained, the superiority of machines over batteries from the point of view of cost of working. SUPPLEMENT, No. **195.**

ELECTRICITY AS A MOTIVE POWER. By Prof. W. E. Ayrton. A careful review of the principles underlying the use of electricity as a motive power; comparing this power with that produced by steam, and showing by calculations and experiment that a dynamo-electric machine, with a separate exciter, driven very fast with a steam engine, or with a stream of water, at high or low pressure, and sending by even quite a fine wire a small current to a distant electro-motor, also running very fast and magnetized by a separate exciter, is an economic arrangement for the transmission of power, either for long or short distances. SUPPLEMENT, No. **198.** Price 10 cents.

ELECTRICAL CLOCKS AND CLOCK Work. By Henry D. Gardner. Description and figures of the principal inventions that have been patented in electrical clocks and clockwork, embracing: Baine's Electrical Pendulum and Dials, Shepherd's System of lifting, by a current, a weight or spring for propelling a pendulum; Jones' Principle of controlling a number of indifferent clocks from one good one; Ritchie's ingenious modification of Jones' system; Dent's further improvements; Bain's plan of setting the hands of indifferent clocks by electricity; Collins' method of Correcting clocks; Ritchie's plan for correcting clocks by hourly currents; arrangement devised in the Great Westminster Clock for reporting its own time to Greenwich; E. J. Dent's method of driving an electric dial. 13 engravings. SUPPLEMENT, No. **198.**

TELEPHONE CALL, HOW TO MAKE.— By George M. Hopkins. Complete working drawings and instructions for making the magneto Call. Also, directions for making several other simple Telephone Calls. SUPPLEMENT **162.** Price 10 cents.

HOW TO MAKE INDUCTION COILS.— By George M. Hopkins. Practical instructions, with full working drawings to scale, sufficient to enable any person to make an efficient coil capable of giving 1½ spark, charging Leyden jars, decomposing water, lighting gas, exploding blasting cartridges, and it will exhibit the phenomena of electric light in vacuo. SUPPLEMENT **160.** Price 10 cents.

HOW TO MAKE A DYNAMO-ELECTRIC Machine.—By George M. Hopkins. Practical instructions, with complete scale drawings. This machine may be run by hand or power. It is easily made; designed for experimental purposes; will heat from 4 to 6 inches of platinum wire; produce the electric light; decompose water rapidly; magnetize steel; ring a large gong; give powerful shocks; operate induction coils; and will, for temporary use, take the place of 8 or 10 Bunsen cells. SUPPLEMENT **161.** Price 10 cents.

THE ELECTRIC LIGHT.—A PAPER containing a detailed description of the principal Electric Lamps of recent date, including the Edison, Sawyer-Man, Wallace-Farmer, Brush, Maxim, Jablochkoff, Rapieff, Reynier, and several others—with over 20 engravings. In SUPPLEMENT **162.** Price 10 cents.

MICROPHONES AND TELEPHONES.— Recent Modifications and Improvements. Twelve engravings, with full directions for making and using. By Geo. M. Hopkins. Contained in SUPPLEMENT **163.** Price 10 cents. These Microphones are easily made and afford a world of amusement and instruction.

ELECTRICAL CABINET.—BY GEORGE M. Hopkins. Description of a simple, cheap, and easily constructed apparatus which the author calls an "Electrical Cabinet," and the parts of which, few in number, are ingeniously arranged so that they may be recombined in various ways to form several different pieces of apparatus to be used in performing a great variety of experiments. The Cabinet may be arranged to form an Electric Engine, a Magneto Machine, a Sounder, an Electric Bell, a Galvanometer, an Induction Coil, Electric Pendulum, etc. This cheap and effective apparatus has been devised for amateur experimenters, old and young, and with the aid of the working drawings and descriptions here given, may be very easily constructed by any one possessing the least mechanical ingenuity. Text illustrated with 14 engravings. SUPPLEMENT, No. **191.**

ELECTRO-MAGNETS.—BY GEORGE M. Hopkins. An explanation of the principles which underlie the construction and operation of electro-magnets, and which, when not thoroughly understood, often puzzle the tyro; showing in addition, how the apparatus is constructed, how the armatures are arranged, and illustrated with 49 figures exhibiting the various forms of electro-magnets generally used for electrical purposes. This paper is especially valuable to those who wish to construct their own apparatus. SUPPLEMENT, No. **182.**

SMALL ELECTRIC LOCOMOTIVE ENgine.—How to make, with dimensions and particulars. Illustrated by engravings. By G. F. Chutter. SUPPLEMENT **19.** Price 10 cents.

THE GRAMME MAGNETO-ELECTRIC Machines. With working drawings, dimensions, and particulars of construction. By M. Tresca. SUPPLEMENT **17.** Price 10 cents.

GALVANIC BATTERIES.—A NEW AND valuable paper. By George M. Hopkins. Containing full instructions for the construction of nearly every known form of Battery, and its maintenance, comprised in three articles in SUPPLEMENTS **157, 158, 159.** Price 10 cents each. This paper includes all of the principal batteries used for Experiment, Telegraphy, Telephony, Electro-metallurgy, Electric Light, running Induction Coils, and other purposes. Also, Earth-batteries, Dry and Moist Piles, Simple batteries, costing only a few cents. Sulphate of Copper, Nitric, Chromic Acid, Quicksilver, Gas, Secondary, and Thermo-electric Batteries are included. It is the most comprehensive paper yet published on the subject. Illustrated with nearly Fifty Engravings.

ELECTRIC CANDLE.—BY W. LUCIEN Scarfe. Description of M. Jablochkoff's Candle, with an account of its Practical Operation, etc. SUPPLEMENT **108.** Price 10 cents.

THE MICROPHONE. — INTERESTING Description, by W. J. Lancaster, F.R.S. 3 Figures. Use of the Instrument in Medicine. How to Make a Most Simple and Entertaining Instrument. Curious Experiments. SUPPLEMENT **137.** Price 10 cents. Also, in same number, A New Mercury Telephone; the Phoneidoscope and the Phonoscope; Reynier's Electric Lamp; Color Blindness, etc.

ON THE APPLICATION OF ROTATING Mirrors to the Measurements of Minute Lengths, Angles, and Times. By Alfred M. Mayer. On Wheatstone's Experiments to Measure the Velocity of Electricity and the duration of the Electric Discharge. *On the Determination of the Velocity of Electricity through conducting Bodies. The Experiments of Feddersen, Henry, Rood, and Mayer on the Nature and Duration of the Electric Discharge. Prof. Rood's researches on the nature and duration of the discharge of a Leyden jar connected with an induction coil. Prof. Mayer's Experiments on the Electric Discharge of the Induction Coil.* Description of Prof. Mayer's apparatus by which the whole history of a flash from the coil is permanently recorded by the discharge itself on a rapidly revolving disk of smoked paper. The new results that have been obtained with this apparatus. This valuable and interesting paper, full of new and remarkable facts, and with 21 cuts illustrating apparatus and experiments, is contained in SCIENTIFIC AMERICAN SUPPLEMENT, **165** and **168.**

SIMPLE ELECTRIC LIGHT APPARAtus. By Geo. M. Hopkins. Two full-size Working Drawings for Easily Made Apparatus, and three drawings, showing all Details of Cells, and How to Arrange in Battery, with full instructions. Contained in SUPPLEMENT **149.** Price 10 cents.

Light, Heat, Etc. Sound.

THE IDENTITY OF THE LINES OF Oxygen, with Bright Solar Lines, as shown in Photographs taken with Increased Dispersion. A paper read by Prof. Henry Draper before the American Association for the Advancement of Science. SUPPLEMENT **194.** Price 10 cents.

EXPERIMENTAL DETERMINATION of the Velocity of Light. A paper read before the American Association for the Advancement of Science, August, 1879, by Albert A. Michelson, U. S. N., describing the buildings, the delicate apparatus, and the methods employed by the author in his experiments to determine with what speed light moves both in the air and in vacuo; and giving specimens of the observations, the data for working out observations, and tables of the results obtained. Illustrated with 12 engravings. SUPPLEMENT, No. **193.**

HOW TO MAKE A PHONOGRAPH. Full Instructions, with Eight Working Drawings, Half Size. Construction easy and Inexpensive. Contained in SUPPLEMENT **133.** Price 10 cents.

COMPACTED BEAMS, TABLING, INdenting, and other methods of Combining Beams, with other Suggestions for the Use of Wood in Works of Magnitude, and Useful Historical Examples. SUPPLEMENT **117.** Price 10 cents.

read before the Association of Municipal and Sanitary Engineers. By E. Buckingham, C.E. With Directions for Making the Best and Cheapest Walks of Cements and other materials. SUPPLEMENT **82.** Price 10 cents.

ON THE MEASUREMENTS OF THE Lengths of the Waves of Light, preceded by short accounts of the Undulatory Theory of Light, and of the Phenomena of Diffraction and Interference of Light. By Alfred M. Mayer. Theories that have been put forth in regard to light. The undulatory theory and facts out of which it has been woven. Experiment to show that one series of sonorous vibrations meeting another series cause silence at their place of meeting. Philosophers led to seek for similar actions in the phenomena of light. The celebrated experiment of Fresnel on interference of light described and explained. Huygen's explanation of the manner in which the waves of ether, causing light, are propagated. Description and explanation of the phenomenon of diffraction of light. The various curious phenomena connected with the diffraction of light, and an explanation of them. The method of measuring the lengths of the different waves of light which cause in the eye the sensation of color. Spectra and Fraunhofer lines as viewed through the diffraction grating. Description of the Spectrometer. The action of a grating on a beam of light traversing it explained. How the waves of light are measured with a grating and a spectrometer. Mascart's improvement in the process of measuring wave lengths. Table of wave lengths of the principal Fraunhofer lines of the solar spectrum. Description of Rutherfurd's ruling-engine for cutting diffraction gratings, with 12 figures illustrating apparatus and experiments. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **175** and **177.** Price 10 cents each.

ON THE DETERMINATION OF THE Number of Vibrations made in a second by a Tuning-Fork, with Examples of the Uses of the Tuning-Fork as a Chronometer to mark and register minute intervals of Time. By Alfred M. Mayer. The Tuning-Fork, an excellent Time-keeper. Experiment to show how it may be made to serve this purpose. How the velocity of rotation of a wheel may be measured by a Tuning-Fork. Description of the apparatus for showing this. How the apparatus is used, how the calculations are made, and the results that are obtained. The laws of falling bodies written on a falling plate by a Tuning-Fork. Examples of its application to such purposes. Experiments to show that with such a simple instrument all the laws of falling bodies may be shown, and a permanent record of them preserved on the smoked plate upon which they were traced by the vibrating fork. The velocities of cannon balls measured by the Tuning-Fork. Description of the apparatus known as the Tuning-Fork Chronoscope. How it is used to determine the comparative velocities of cannon balls given by various qualities of gunpowder, and the importance of such tests to the efficiency of an army. The speed with which the nervous motor and sensitive agent travels along the nerves measured with the Tuning-Fork. Explanation as to how the fork is used almost universally in physiological experiments to time the speed of the nervous motive agent and the contractile waves in the muscles. The graphic results of such an experiment shown by means of a figure. The interesting facts that have been observed by experiments of this kind on man and the lower animals. Illustrated with four engravings. SCIENTIFIC AMERICAN SUPPLEMENT, No. **160.**

THERMOMETERS. — BY R. J. MANN. The common thermometer, and how made. Sensitive, Maximum, Minimum, and Registering Thermometers. Radiation Thermometers; Clock Register Thermometers; Deep-sea Thermometers; Self-moving and Registering Thermometers. The uses to which the Thermometer is put, etc. SUPPLEMENT **59.** Price 10 cents.

THERMOMETER SCALE. — A VERY Useful Combination Scale, full Size, enabling an Instantaneous Comparison of Numbers on the Fahrenheit, the Reaumur, and the Centigrade Thermometers; with Formulæ for Converting the Units of one scale into Units of another Scale. SUPPLEMENT **141.** Price 10 cents.

IMPROVED REFLECTING MAGIC LANtern.—By J. B. Knight. One engraving. Showing how to construct an Exceedingly Cheap, Useful, and Convenient Lantern by which images of paper photographs, engravings, drawings, paintings, and other opaque objects may be enlarged and thrown upon the screen. SUPPLEMENT **87.** Price 10 cents.

HORIZONTAL PENDULUM FOR THE Minute Measurement of Gravitation, Delicate Vibrations, and Microscopic Lengths. Entertaining Description of a Simple and Wonderful Instrument, and How it Responds to the Motions of the Heavenly Bodies, and can Measure the Velocity of Gravitation; with four figures. SUPPLEMENT **112.** Price 10 cents.

Astronomy.

ANOTHER WORLD INHABITED LIKE our own. A most interesting description of the planet Mars and its satellites by that renowned astronomer and brilliant French writer, Camille Flammarion. The planet Mars, which comes next to the earth in order of distance from the sun, has been the object of especial study with the author, who was desirous of finding therein a confirmation of his theory of the plurality of the inhabited worlds. Some of the more important points treated of are: The atmosphere of Mars, and its clouds; the geography of the planet; its snow-clad poles; the analogy of the martial climates with those of the earth; the red color of the continents of Mars, and the green color of its seas; the author's theory that the red color is due to the peculiar hue of the vegetation of the planet; the meteorology of Mars shown to be very similar to that of the earth; Mars, like the earth, the former seat of interior geologic changes; map of Mars as constructed by the author after comparing more than 1,000 telescopic drawings, the diameter and superficial area of Mars; its density; force of gravity at its surface; beings living on Mars are necessarily only one-third as heavy as terrestrial beings; conclusions of the author that the inhabitants of Mars are fitted for flying in its atmosphere; the satellites of Mars, their minute size, and their periods of revolution. Illustrated with two engravings. SUPPLEMENT, Nos. **175** and **180.** Price 10 cents each.

THE GIANT OF THE WORLDS—BY CAmille Flammarion. A description of the colossal planet Jupiter; its diameter, circumference, mass, velocity, and distance from the sun and earth; the length of its days and years; the curious speculations that have been made in regard to its inhabitants; its meteorological conditions; its curious bands, their number and appearance and probable constitution; the time of the planet's rotation as ascertained by different observers; probable geological state of the planet at the present time; the probability of its being inhabited and speculations as to the nature of the beings who dwell upon it; the planet's four enormous satellites, their days and seasons, and the probability of their being inhabited; aspect of Jupiter as seen from his satellites; how the sun appears as viewed from the satellites; the earth as it must appear to the inhabitants of Jupiter. Illustrated with one engraving. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **196.** Price ten cents. To be had at this office, and from all newsdealers.

VENUS, THE EVENING STAR. AN INteresting and valuable paper. By Camille Flammarion. Containing a resume, in popular form, of the latest knowledge concerning this wonderful planet, which is nearly of the same size as the earth and only twenty-six millions of miles distant from us. Including an account of the phases of Venus, its remarkable brilliancy, periods when seen in the daytime, its density, probable atmosphere, climate, physical features, deductions concerning life and inhabitants, etc., with one illustration. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **177.** Price 10 cents. To be had at this office and of all newsdealers. The same number also contains a valuable paper by Alfred M. Mayer, on the Measurements of the Waves of Light, with a drawing and description of the mode of using the Spectrometer.

These papers may be had at THE SCIENTIFIC AMERICAN Office, New York, or may be ordered through any Bookseller or Newsdealers. In ordering, please be particular to specify **the Number** of the Supplement that contains the paper desired. Promptly sent by mail to any part of the world. Price Ten Cents each Number.

Astronomy.

THE MODERN TELESCOPE.—BY J. Norman Lockyer, F.R.A.S. Nine illustrations. The Vast Advances Made in Recent Times. Magnifying Power, Focus, Apertures. Diffraction Rings. Illuminating Power of the Telescope. Gemini and Orion as seen by the Naked Eye and by the Telescope. Testing of the Glasses; Defining Power; Double Stars. "Spurious Disk." Climate. Adjustment of Object-glass. A Capital Test Object. Wonderful Perfection of the Modern Object-glass. Saturn as seen by Telescopes of various sizes. Absorption and Imperfect Reflection. Relative Efficiency of Reflector and Refractor. Ventilating or Lattice Tubes. Permanence of Optical Properties. Silvering and Mounting Mirrors, and many Practical Instructions. SUPPLEMENTS **107, 111, 114.** Price 10 cents each.

Meteorology.

METEOROLOGICAL REGISTERS.—By M. Marie-Davy. Description of the various meteorogical apparatus used at the Montsouris Observatory, embracing: The Registering Barometer, the Barograph, the Micrometer for reading curves traced by the Register, the Thermograph, the Psychrometer, the Earth Thermometer, the Actinometer, the Atmograph, and the Anemograph. Illustrated with 5 engravings of apparatus, and one diagram, showing specimens of curves made by the various registers. SUPPLEMENT, No. **198.**

Natural History, Geology, Biology.

MT. RANIER OR TAKHOMA.—A DEscription by Hazard Stevens of his ascent of this remarbable Volcano in Washington Territory. This narrative, of absorbing interest to both the Naturalist and the general reader, gives the Geography of the region; the Toils, Perils, and Adventures of the expedition; Discovery of a Cavern in the Crater; A Night in the Volcano; The Stupendous Glacial System of the Mountain and the vast River it Feeds. SUPPLEMENT **59.** Price 10 cents.

POLLEN.—BY W. G. SMITH. ILLUSTRAtions and descriptions of 93 varieties of Pollen from well-known plants, and the hybrids between these curious forms. SUPPLEMENT **62.** Price 10 cents.

CATASTROPHISM. — BY CLARENCE King. Address delivered before the Sheffield Scientific School, Yale College. Catastrophism and Evolution. Uniformitarianism. America formed by Catastrophes. Field Records of Catastrophes. Importance of Environment. SUPPLEMENTS **80** and **81.** Price 10 cents each.

STUDIES OF MATTER AND LIFE.—BY Prof. Henry J. Slack, F.R.S. A most interesting and valuable paper, explaining the latest scientific theories, researches, and calculations concerning the various Modes of Motion, the Ether of Space, the Transmission of Wave Forces, the Limits of Vision, the Size of Atoms, Motion, and Force of Atoms, Grouping of Atoms, Phenomena of Reproduction, Mental Phenomena. SUPPLEMENT **27.** Price 10 cents.

THE THEORY OF EVOLUTION.—THE three great lectures delivered in New York, 1876, by Professor Huxley, on "The Theory of Evolution." SUPPLEMENTS **41, 42, 44.** Price 10 cents each, 30 cents for the three. These are the only scientific lectures delivered in America by Professor Huxley.

THE PHENOMENA OF HUMAN LIFE.—An address by Professor John Tyndall. A most able and interesting paper, in which the Laws of Energy and the Continuity of Motion as they are found in the material universe are pointed out and their existence traced in the Animal Economy and the Human System. The operation of the Will and the Relations between the Mind and Body are described in the clearest manner from the standpoint of the man of science. SUPPLEMENT **97.** Price 10 cents.

MAN AND HIS STRUCTURAL AFFINITIES.—Abstract of a Lecture delivered before the Buffalo Society of Natural Sciences. By A. R. Grote. A valuable and interesting paper, with 28 figures. Remarkable similarity of the Bony Structure of various animals. The Gorilla, with Portrait. The Gorilla compared with Man. The Chimpanzee, the Orang-outang, and several Apes and Monkeys. Our Relation to the Anthropoid Apes. Comparative Brain Development. SUPPLEMENT **148.** Price 10 cents.

BIOGRAPHICAL SKETCH OF AN INFANT.—By Charles Darwin. An interesting Biological study. Reflex Actions; Dawn of Reason and Emotion; first indication of the Moral Sense; Acquisition of Language, etc. SUPPLEMENT **86.** Price 10 cents.

ANCIENT LIFE IN AMERICA.—AN address, by Prof. O. C. Marsh, recently delivered before the American Association for the Advancement of Science, Nashville, Tenn. Prof. Marsh, who is so widely known for his remarkable Western Discoveries, especially of American Fossils, presents in this address a connected history of the dawn and progress of Life in America, as shown by the latest deductions of Science, and confirmed by his extraordinary Geological Collections. This paper is full of fresh information, and forms one of the most interesting and valuable contributions to science ever given to the public. SUPPLEMENTS **90** and **91.** Ten cents each.

PLANT AND ANIMAL LIFE.—BY PROF. A. R. Grote. A highly instructive and interesting lecture, illustrated with 20 engravings, and giving in a popular style a full exposition of the phenomena of Life from its first manifestation in the very lowest organisms up to its perfect development in man. Plants and animals made out of the atmosphere. Life invariably associated with motion. The development of life. Protoplasm. Growth of plants and animals. Organisms that are neither plants nor animals. Æthalium. Difference between plants and animals. Spontaneous generation. Bathybius. Protamœba. Multiplication of Fresh Water Amœba. Growth of Red Snow. Structure and growth of Bryopsis. Description of Euglæna. Eggs of the higher animals have first the Amœba form, and subsequently divide like Euglæna; what the ultimate stage is to be, whether Euglæna, Amœba, fish, bird, dog, or man, not to be determined from the organic contents of the original egg itself. Science in detecting the process of evolution asserts the unity of all Nature. II.—Cell formation. All eggs are but specialized cells. Development of the Sponge. Cell development as it appears in the class of worms. Development of the tape worm. The higher worms—the Ascidians and their embryos and larvæ. Vertebrates with no skull, nor brain, and no true heart; the Amphioxus and lamprey. Description of the Amphioxus. Origin and development of the nervous system. The relative ranks of animal groups influenced by the forms assumed by species in their development. The Common Crab, its zoea and megalops stage. The Toad and its transformations. Comparative structure of the legs of the toad and bird, and the wing of the latter. Ancient birds with teeth. The succession of animals in geologic ages. The more fossils we find, the more clearly the history of the gradual development of present species is made out. The differences now found between birds and reptiles at one time did not exist. Development of the brain. Evolution of the horse. Evolution of man; he passes in his embryology through changes in which he resembles all existing animals. Experiments in transforming the Mexican Axoloti. The brain, the nerves, instinct, and reason. No nerves, no mind. Difference between instinct and reason one of degree, not of kind. SUPPLEMENT, **179** and **185.**

FOREST TREE BORERS.—BY MARY E. Murtfeldt. Rapid Decadence of our Forests, and How it is Caused. The Wood-boring Beetles. The Bark-borers. The Wood Weevils, the Saw-horn Wood-borers, and the Capricorn Beetles. The Larvæ. The Enemies of the Hickory, the Ash, the Walnut, the Elm, the Beech, and the Pine. A very Singular Insect, the Twig-Girdler. Interesting Description of these Insects, their Habits, their Parasites, etc., with Directions for Preserving Trees, contained in SUPPLEMENT **131.** Price 10 cents.

MYTHOLOGIC PHILOSOPHY.—VICEPresidential Address of Prof. J. W. Powell, read before the American Association for the Advancement of Science, August, 1879. SUPPLEMENTS **193** and **194.** Price 10 cents each.

MATERIALISM AND ITS LESSONS.—By Dr. Henry Maudsley. A calm and impartial review of the doctrine of Materialism by one who believes that "Materialism," when properly understood, far from being a menace to morality, only sets before man a higher intellectual aim than he is ever likely to reach by spiritual paths. The author treats his subject under the following headings: Mental Effects of Injury to the Brain; The Moral Character first Impaired; How Disease injures the Moral Character; Mental Effects of Paralysis; Effects of Alcohol and Opium on the Moral Sense; Dependence of Mind and Spirit on Organization; the doctrine of a Separate Spirit; the Hope of Immortality; Lessons of Humility and Reverence; Brain Differences and Values; Teachings of Science Concerning the Growth of Moral Character; Causes of Family Development and Degeneracy; Hereditary Antecedents; How Mental Derangement is produced by Absence of Moral Feeling; Obedience to the Higher Laws imperatively required; Stern and Uniform Reign of Law in Nature; the Events of the Moral World as a Matter of Law and Order; the Good of Mankind and the True Object of Life. Contained in SUPPLEMENT, No. **197.** Price 10 cents.

POLYDACTYL HORSES, RECENT AND Extinct.—By Prof. O. C. Marsh. A valuable paper, illustrated with 10 engravings showing the comparative morphology of the teeth and anatomy of the feet of recent and extinct horses. SUPPLEMENT, No. **188.** Price 10 cents.

HISTOLOGY AND THE CELL-THEORY. —By Dr. Edouard Fournié. Examination of Germany's Claims in Microscopy. De Mirbel, Turpin, Raspail, Duvernois, Coste, and others, and the History of the Cell-Theory. Fundamental Principles of the Theory according to Schwann. Labors of Vogt, Bergmann, Vogel, Goodsir, Kolliker, Luschka, Bischof, and Donders. M. Virchow's ideas. The Analogies in the Vital Manifestations of Organisms and Unicellular Animals. The Essential Point in the Inquiry. Cells Live, but do not Perform Function. The Ovule and the Cell. The Question of Geometric Form. The famous Cellular Territories. Nutrition not Permanent. Irritation necessary to Nutrition. Contained in SUPPLEMENTS **137, 140, 142, 144.** Price 10 cents each.

THE CAÑONS OF THE COLORADO.—Compiled from the Report of Prof. J. W. Powell, Geologist in charge of the Geographical and Geological Survey of the Territories. With Forty-eight Engravings. History of the Original Exploration. A peculiarly Exciting and Dangerous Voyage. Strange and Gigantic Scenery, with Engravings of Green River; Parunuweap Canon; Gate of Lodore; Marble, Gypsum, Kanab, and Grand Canons; Mouth of the Little Colorado; Geography of the Colorado River Basin, with large Map. Strange Geological Features; the Buttes, the Bad Lands, the Hog-back Valleys, the Terrace Cliffs, and description of Faults and Folds. Land of Standing Rocks, Island Monument, Grottoes, Towers, Amphitheaters, and Caves. Stupendous Denudation by Rains; Mountains Carved from Level Plains. A Land of Grotesque Monuments, and its Strange Geological History. With brief account of the Indians of the region and their habits, and of the Interesting Archæological Relics of an Ancient Unknown Race. SUPPLEMENTS **118, 121, 124, 131, 135.** Price 10 cents each.

HISTORY AND METHODS OF PALÆontological Discovery. Address delivered at the Saratoga Meeting (1879) of the American Association for the Advancement of Science. By Prof. O. E. Marsh, President. An important and valuable paper. SUPPLEMENT, Nos. **193** and **194.** Price 10 cents each.

THE FOSSIL FOREST OF THE YELLOWSTONE NATIONAL PARK. By W. H. Holmes. A very interesting and valuable paper descriptive of the remarkable "Volcanic Tertiary" formations of the above region, 5,500 feet in thickness. Illustrated by an engraving of the north face of Amethyst mountain, 9,400 feet high, the river bed 6,700 ft. high, showing the position of the multitudes of ancient forest tree trunks of gigantic size turned into stone, and now standing on the cliffs, together with many other interesting geological particulars. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **80.** Price 10 cents.

PROTOPLASM.—A PAPER READ BEfore the British Association for the Advancement of Science, by the President, Prof. G. J. Allman, M.D., F.R.S., Aug. 20, 1879. Protoplasm in its most generalized aspect. The reality of the "Bathybius," the famous Amœba. The Individuality of the Cell. The Society of Cells. The Uniformity of Protoplasm. The Myxomycetæ. Cell Multiplication. Rejuvenescence. The Egg a Typical Cell. The Clearage of the Egg. Formation of Plasmodia. Chlorophyl. No Dualism in Life. The fundamental differences in Protoplasm. Life a Property of Protoplasm. Is Thought a Property of Protoplasm? SUPPLEMENT, No. **195** and **196.**

Archæology.

PERUVIAN ANTIQUITIES. BY E. R. Heath, M.D., the most recent visitor to the home of the Incas. An intensely interesting account of the Remarkable Ruins and Walls of the Jequetepeque Valley, Peru. The prisons of Pizarro and Atahualpa. Description of the Wonderful Huacas, or burial mounds, near Truxillo. Accounts of the immense treasures of Gold that have been found in the Huacas. The immense Huacas, near Ancon and Passamayo, and the interesting relics found therein. The extensive ruins of the Huatica Valley. The Huaca of Pando. The Huaca of the Bell. Description of the Temples and Fortresses of the Huatica Valley. The Huaca of Ocharan, the largest burial mound in the valley, inclosing 117 acres. The great Inca Temple of the Sun, in the Valley of Lurin, and its dimensions. The extensive ruins in the Canete Valley, and the interesting relics that have been discovered in them. The effects of earthquakes that have taken place on the Peruvian coast. The extraordinary Masonry composing the walls, temples, houses, towers, etc., in the Mountain districts. The wonderful Structures in the City of Cuzco. The Ruins on the Islands in Lake Titicaca. The notable Ruins at Chavin de Huanta, Corralones, Huaytar, Nazca, and Quelap. Half a Million Miles of Wonderful Stone Wall, averaging 3 to 4 feet high, and enough to encircle the globe ten times! Who were the people that constructed this and the other wonders of Peru? The Ancient Peruvian Records and what we learn from them. The geologic changes that have taken place in Peru; the rising and sinking of its coast, and the several risings and sinkings of the Andes. Speculations as to whether a great continent once occupied the present site of the Atlantic. This valuable paper, by a well-known American Archæologist and a close and patient observer, contains much that is new, and is written in an exceedingly pleasant style. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **158** and **159.** Price 10 cents each.

ARCHÆOLOGICAL EXPLORATIONS IN TENNESSEE. By F. W. Putnam. An exceedingly interesting narrative of Prof. Putnam's explorations of the celebrated burial mounds of a prehistoric race in the State of Tennessee; illustrated with 55 engravings, copied from the author's own drawings, of the various relics found by him, such as Weapons of War, and Household Implements, in Jasper, Flint, Hornstone, Copper, and Bone; Ornaments of Shell, Copper, and Flint; Earthern Jars, Pots, Bowls, and Dishes, many of them of very curious shapes, and Pipes of Stone and earthernware of singular and interesting forms. Accompanied by descriptions of the various articles, and a map of the locality where found. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **169, 170, 171, 172,** and **173.** Price 10 cents each, or 50 cents for the series.

Medicine and Hygiene.

DENTITION.—BY RICHARD A. F. PENrose, M.D. A very instructive lecture delivered before the Medical Class of the University of Pennsylvania, upon a subject of vital importance to the welfare of the Infant in both health and disease. SUPPLEMENT, No. **167.** Price 10 cents.

THE SPONGY IRON FILTER. — BY Gustav Bischof. A paper read before the Royal Society. Defective means of detecting Bacteria and Putrescent Matter in Water, and Sanitary Danger of Water so contaminated. Description of Filter which removes these Organisms, and Experiments proving its value. With other valuable papers on the Origin of Bacteria, the Cell-doctrine in the Light of Recent Investigations, etc. SUPPLEMENT **87.** Price 10 cents.

FOOD, PHYSIOLOGY, AND FORCE.—By Dr. E. L. Sturtevant. An interesting and comprehensive paper presenting many valuable and instructive facts. Food a form of force; the animal a product of force or forces; definition of "work;" the amount of force derived from various articles of food. Table of food, showing total mechanical work which the combustion in the body of one pound of each is capable of producing outside the body; the weight of the body; object of respiration and circulation; phenomena of respiration and circulation; animal heat; consumption of force in standing and walking; changes in the amount of food to furnish force for purpose of labor; amount of food required by man and animals; the force-producing powers of milk and beef compared; proper protection of animals in winter a cheaper fuel than corn or hay. SUPPLEMENT, No. **186.** Price 10 cents.

ALCOHOLISM. — AN INTERESTING Paper upon the Relations of Intemperance and Life Insurance. The average Risks and Expectancy of Life of the Temperate and of the Intemperate. Physiological action of Alcohol; stimulating the Nervous System, Retarding the Circulation. Alcohol Oxidized in the System. Insomnia, Congestion of the Lungs, Deterioration of Structure, Calculus, and Liver Diseases as results of Liquor. Extended Medical Testimony. SUPPLEMENT **125.** Price 10 cents.

THE MEDICINAL USE OF ALCOHOL and its Dangers.—By J. D. Crothers, M.D. Being Clinical Studies of the Histories and Early Causes of many Cases of Inebriety. With Medical Testimony and Remarks on several Remedies having Alcohol as a Base. Contained in SUPPLEMENT **142.** Price 10 cents.

THE ART OF PRESERVING THE EYEsight.—Adapted from the French of Arthur Chevalier. Illustrated with 93 engravings. A plain, comprehensive Treatise, explaining the Anatomy of the Eye; the Phenomena of Vision, and the Reflection, Refraction, and Dispersion of Light; the Ophthalmoscope and its Use; Diseases of the Eye, and Treatment; Long and Short Sight, with Instructions; Cataract and Astigmatism; Manufacture of Spectacles; Colored Glasses and their Use; Number and Foci of Lenses and their Mountings; Hygiene of the Eye. Valuable Directions for all; the Hygiene of the Eye. Simple Home-treatment for Weak Eyes. Care for the Eyes of Children and Infants. What Lamps should be Used. How to Bathe the Eye. Instructions to the Aged. Extraction of Foreign Bodies from the Eye. Eye-washes and their composition. Recipes for Eye-washes and Directions for their Application. The whole contained in SUPPLEMENTS **125, 127, 130, 136, 139, 142, 144, 147.** Price 10 cents each; 80 cents for the series.

OPEN AIR FOR CONSUMPTIVES.—BY H. B. White. Importance of Open Air for Disease. Lessons of the Late War. Cold Air not injurious to Diseased Lungs. Consumption simply the result of Foul Air. Florida, and other Health Resorts. The Hawaiian Islands. Description of the Climate and its Wonderfully Salutary Effect, with cases of Consumption Arrested there. SUPPLEMENT **107.** Price 10 cents.

TREATMENT OF TYPHOID FEVER.—By Alfred L. Loomis, M.D. How to Reduce the Temperature. How to sustain the Vital Power. How to maintain Nutrition, and Practical Directions on Diet. This important lecture, with numerous additional Medical Essays on Lymph; Hydrophobia cured by Oxygen; Chloral Hydrate in scalds and burns; Brown-Sequard on Nerve Disease; Therapeutic Uses of Zinc Cyanide, etc. SUPPLEMENT **60.** Price 10 cents.

MEDICAL PRESCRIPTIONS AND FORmulæ.—The following New Remedies, viz.: Cosmoline Cream, Mistura Antispasmodica, Elixir of Monobromated Camphor, Effervescing Carbonate of Iron, Emollient Glycerine Lotion, Podophyllin Pills. The following Standard Formulæ, determined by the Societe de Pharmacie of Paris for certain new preparations, with full directions for preparing Salicylic Acid, Thymic Acid, Crystallized Aconitine, Ammonium Bromide, Apomorphia, Theine or Caffeine, Bibasic, Calcium Phosphate, Sirup of Calcium Chlorhydrophosphate, Sirup of Calcium Lactophosphate, Sirup of Acid Calcium Phosphate, Glycerole of Calcium Saccharate, Liniment of Calcium Saccharates and other valuable items. Formulæ, etc., as the following: Solution of Bromide of Arsenic, Analysis of Ride's Food, Ammoniated Tincture of Guaiacum in Inflamed Throats, Gargle for Sore Throat, How to cure a bad cold, Digestive Pastilles of Borivent, "Sulphur Pills," etc. SUPPLEMENT **75.** Price 10 cents.

LECTURES ON PARALYSIS AND CONvulsions, as Effects of Organic Diseases of the Brain. By C. E. Brown-Sequard, M.D. Delivered at Bellevue Hospital Medical College, New York. Being reports of eight celebrated lectures of importance and value. Contained in SUPPLEMENTS **101, 102, 103, 104, 109, 112, 119, 121.** Price 10 cents each.

DEAFNESS—THE ORGAN OF HEARing in Health and Disease.—By W. S. Bowen, M.D. An essay on Curable and Preventable Deafness, describing the different components of the Organ of Hearing in Health, and entering into a consideration of those Diseases and conditions attended by loss of Hearing that are readily amenable to successful treatment if attended to. A plain, practical paper, devoid of technicalities, and readily understood by the general reader. SUPPLEMENT, No. **166.** The same number contains an interesting paper on "Wax in the Ears," by William A. Hammond, M.D.

CATARRH.—BY DUDLEY S. REYnolds, M.D. Character of the Disease. The Epizootic as Catarrh. Acute, Chronic, and dry Catarrh. Treatment, Appliances, etc. Additional subjects, as Milk Diet, Treatment of Rheumatism, Removing Foreign Bodies from the Eye. Is Consumption Inoculative, etc. SUPPLEMENT **84.** Price 10 cents.

MEDICAL USES OF CARBOLIC ACID. Clinical Lecture delivered at the Norfolk and Norwich Hospital, Eng., by Peter Eade, M.D. Properties of the Acid, and its Medical Preparation and Action. Bacteria, and How Destroyed. Boils, Carbuncles, Festers, Ringworms, etc., cured by Carbolic Acid. The Healing of Strumous Sores assisted by Carbolic Acid. Carbolic Acid in Excoriation or Ulceration of the Neck of the Uterus, in cases of Phthisis, and in some Stomach Disorders. Two cases of Successful Treatment of Carbuncle by Carbolic Acid. SUPPLEMENT **138.** Price 10 cents. Also, in same number, the Alkaline Treatment of Burns and Scalds; Danger from Hypodermic Injection of Morphia; Strumous Disease Treated by Volcanic Vapors, etc.

THE PREPARATION OF SKELETONS for Museum Purposes.—By Prof. W. H. Flower, F.R.S. Simple Practical Directions giving the several Methods. SUPPLEMENT **106.** Price 10 cents.

SEWER-GASES, AND THE TRANSPORT of Solid and Liquid Particles therein.—By E. Frankland, F.R.S. Experiments and Practical Experience proving the suspension in the Atmosphere of Solid and Liquid Particles from Sewers, to which matter Cholera and other diseases have been traced. Sanitary Prevention. Other excellent articles on Medical, etc., subjects, as the Treatment of Rheumatism; Croton Chloral in Whooping Cough; School of Life and Myopia; Safe Administration of Chloroform, etc. SUPPLEMENT **67.** Price 10 cents.

GROUND-AIR IN ITS HYGIENIC RElations.—By Dr. Max Von Pettenkofer, Professor of Hygiene in the Munich University. An important and valuable paper, proving by experiment the existence of underground air-currents; sanitary dangers from the escape of underground air into dwellings. SUPPLEMENT **82.** Price 10 cents.

A COMBAT WITH AN INFECTIVE ATmosphere.—A Lecture delivered at the Royal Institution, by John Tyndall. A series of important Experiments described. How the Putrefactive Power of Air may be removed. Organic Infusions kept clear for months in contact with air. Facts tending to Disprove Spontaneous Generation. This Remarkable Lecture, with essays on the Formation of Raindrops and Hail, the Chemical Harmony of the Universe, and like entertaining subjects. SUPPLEMENT **65.** Price 10 cents.

HYGIENE OF THE HAIR.—BY PROF. Erasmus Wilson. Cleanliness of the Hair, and how to secure it. Cures for Baldness. Gray Hair, and its Cure. Dyeing condemned. SUPPLEMENT **102.** Price 10 cents.

YELLOW FEVER.—A HIGHLY INstructive lecture recently delivered by Prof. Alfred Stillé, M.D., LL.D., before the Graduating Class of the Medical Department of the University of Pennsylvania. The earliest accounts that we have of Yellow Fever. Its Origin. The Seeds of Trans-Atlantic Epidemics Imported from America. The Disease has never originated outside of the West Indies. The Conditions which generate Yellow Fever. The Disease proved to be of limited Local Origin. The Efficacy of rigid Quarantine. Circumstances which influence the Diffusion and Fatality of the Disease. The Comparative Immunity of the Colored Race. The Essential Cause of Yellow Fever. The Germ-Origin not Proven. Death not caused by Uræmia. The Contagiousness of the Fever. The Disease transported by *Things* and not by Persons apart from their Clothing. Its Non-Contagiousness; the Disease not Transmitted from one Person to another, but generated in the System. The Disease an Infectious One. The Rapidity with which the Yellow Fever Poison is Diffused. Progress of the Fever arrested by a Low Temperature. The Pathology of the Disease. An Explanation of the Black Vomit. The Liver and Kidneys in Yellow Fever. Summary of the Ground thus far gone over. The Forms of Yellow Fever. The Symptoms of Inflammatory Yellow Fever. The Malignant Type of the Disease. The Prognosis of the Disease. Diagnosis of Yellow Fever. Treatment. No Specific for the Disease. SUPPLEMENT, No. **160.** The same number contains a valuable paper on "Chronic Articular Rheumatism and Rheumatoid Arthritis," their Symptoms and Treatment.

TREATMENT OF ORGANIC HEART Disease. By William Pepper, M.D. A Clinical Lecture devoted to the consideration of the following topics: (1). Treatment of the Functional Embarrassment, embracing all the various kinds of local Congestions and Effusions; (2) Treatment of the Cardiac Distress; (3) The proper management of the Heart Lesion itself. SUPPLEMENT, No. **172.**

RELATIONS OF DYSPEPSIA WITH Constitutional Diseases.—By Dr. J. Cornillon. Remarkable Sympathy between the Stomach and other Organs. The Etiological Value of Dyspepsia in Diathetic Diseases. Gastric Troubles a Determining Cause of Pulmonary Phthisis, with two Cases. Opinions of Beau, MM. Herard and Cornil, Andral, M. Bouchardat, and others. Carcinoma of the Stomach. Dyspepsia in Arthritic Disorders. Dyspepsia one of the first Visceral Manifestations of the Uræic Diathesis, with Clinical Facts. Dyspepsia and Gout Alternate. Dyspepsia the Effect of Rheumatism. General Characteristics of Dyspepsias dependent on Diathesis and on certain Chronic Diseases. A Dyspepsia being given, can we Diagnosticate the Diathesis or the Chronic Disease on which it Depends? Abnormal Appetite of Diabetic Patients. Dyspepsia producing Nervous Disorders. How to Distinguish between Idiopathic and Symptomatic Dyspepsia. Alcoholic Dyspepsia. Contained in SUPPLEMENT **133.** With A NEW FORM OF FIELD TOURNIQUET; PLASTER OF PARIS SPLINTS. Abstract of a Clinical Lecture, by John Croft, F.R.S., with How to Make and Use the Splints, and Useful Remarks on Fixed Bandages. Also, an article on the Progress of Nerve Surgery, and a Biographical Sketch and Portrait of William Harvey. Price 10 cents.

NERVOUS EXHAUSTION.—BY GEO. M. Beard, M.D. A Comprehensive treatise, giving the Literature of the Disease, and the following symptoms, with Valuable Remarks upon each: Tenderness of the Scalp, Spine, and the whole Body; General or Local Itching; Abnormalities of the Secretions; Tenderness of the Teeth and Gums; Vague Pains and Flying Neuralgiæ; Flushing and Fidgetiness; Tremulous and Variable Pulse and Occasional Palpitations; Sudden Giving Way of General or Special Functions; Idiosyncrasies in Food, Medicine, and External Irritants; Sensitiveness to Changes in the Weather; Feeling of Profound Exhaustion; Desire for Stimulants and Narcotics Ticklishness; Insomnia. Nervous Dyspepsia; Partial Failure of Memory; Sexual Exhaustion; Deficient Mental Control; Seminal Emissions; Changes in the Expression of Eyes and Countenance; Mental Depression with General Timidity; Morbid Fear of Special Kinds; Fear of Society; Sick Headache; Pain and Heaviness in the Head; Disturbances of the Nerves and Organs of Special Sense; Muscæ Volitantes; Noises in the Ears; Localized Peripheral Numbness and Hyperæsthesia; General and Local Chills and Flashes of Heat; Local Spasms of the Muscles. Suggestions for Treatment. Nervous Symptoms Interchangeable. The Periodical or Rhythmical Character of the Symptoms. Nervous Exhaustion compatible with Appearance of Perfect Health. This Disease to be Studied only in Private Practice. Treatment to be of Sedative and Tonic Character. Application of Electricity; Counter-irritation; the Cooling Catheter, etc. Food and Medicine. Contained, with a Valuable Treatise on the Art of Preserving the Eyesight, in SUPPLEMENTS **135, 136.** Price 10 cents each; 20 cents for the two.

HOT WATER TREATMENT.—SERVICE of Dr. Frank H. Hamilton, Bellevue Hospital. Amputation Obviated. Recovery from Gangrenous Slough, etc. SUPPLEMENT **117.** Price 10 cents. Also, in same number, valuable Medical Notes on Bloodless Tracheotomy, Cholera, Internal Fat, Diabetes, Death of M. Claude Bernard, Blue Bile, the London Smallpox Epidemic, Fatal Laundry, Disinfecting in Dublin.

These papers may be had at THE SCIENTIFIC AMERICAN Office, New York, or may be ordered through any Bookseller or Newsdealers. In ordering, please be particular to specify **the Number** of the Supplement that contains the paper desired. Promptly sent by mail to any part of the world. Price Ten Cents each Number.

Medicine and Hygiene.

ERRORS IN DIET.—BY DR. WILSON, F.R.S. The Sufferings from Wrong Diet. How Nutrition and Economy can be combined. Proper Diets for the Working Man, for Infants, and for Children. Best hours for Meals. Drinking Tea and other Stimulants. SUPPLEMENT **94.** Price 10 cents.

DYSPEPSIA.—BY DR. C. F. KUNZE. Symptoms. Appetite Diminished. Stomach Digestion much slower than Normal. Constipation. Symptoms in Children. Chronic Cases. Dyspepsia as caused by too much Food: by Indigestible Food; by General Derangement: by Altered Conditions of Innervation. Treatment. Nourishment should be Easily Digestible; taken Little at a Time, and Digested before more is taken. Necessity of Few and Plain Dishes. Treatment when Stomach is Overloaded. Aiding Gastric Juice. Treatment in Febrile Diseases. Contained in SUPPLEMENT **129.** Price 10 cents.

CATARRH.—BY DUDLEY S. REYnolds, M.D. Character of the Disease. The Epizootic as Catarrh. Acute, Chronic and Dry Catarrh. Treatment, Appliances, etc. Additional subjects, as Milk Diet, Treatment of Rheumatism, Removing Foreign Bodies from the Eye, Is Consumption Inoculative, etc. SUPPLEMENT **84.** Price 10 cents.

ON CHRONIC MALARIAL POISONING.—By Alfred L. Loomis, M.D. A Highly Instructive Clinical Lecture, delivered at the University Medical College, N. Y. According to Professor Loomis, the effects of malarial poison are manifested in a surprising variety of forms and symptoms; so numerous and various, in fact, that they cannot be tabulated. They embrace enlargement of the spleen, neuralgias of different forms, that may or may not be periodical; dyspeptic troubles which cannot be relieved by dyspeptic remedies; headaches that are often treated as cerebral diseases; confusions of mind; staggering gaits; loss of power in portions of the body; impairment of mental faculties; inability to do work of any kind; not sick enough to go to bed, but too ill and habitually too tired to perform anything that requires the least exertion; shortness of breath; rapid, weak, irregular pulse; sleepless nights, etc. The infection appears to be far more widely spread than is commonly supposed; and all who have ailments that fall within the category here mentioned will do well to read this excellent lecture. SUPPLEMENT **102.** Price 10 cents.

THE GLANDULAR ORIGIN OF CONtagious Diseases.—Address by B. W. Richardson, M.D., President of the Sanitary Congress, England, presents the Latest Researches and Facts concerning the Origin of Diseases, such as Small-pox, Measles, Scarlet fever, Diphtheria, Typhus fever, Typhoid fever, Erysipelas, Hospital fever, Puerperal fever (or the fever which occurs to women in child-bed), Cholera, Yellow fever, Ague, Glanders, Boil and Carbuncle, Infectious Ophthalmia, showing that these diseases are caused by organic poisons, how they are spread, and how they may certainly be prevented. This is one of the most valuable, important, clear, and interesting papers ever produced on this subject. SUPPLEMENTS **99** and **100.** Price 10 cents each.

ON THE CURE OF CONSUMPTION.—By James H. Salisbury, M.D. The author, who has been treating consumption successfully for the last twenty years, states that if the directions given in this paper are faithfully followed out and persisted in, Consumption in all its stages becomes a curable disease. His method, which is herein given complete, embraces the drinks and food that are to be used, the clothing that should be worn, the baths and exercise to be taken, directions as to meals, and the treatment, which includes prescriptions for the medicine to be employed, and directions for taking. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **198.** Price 10 cents.

THE CONDITIONS OF HEALTH IN THE Infant—A lecture delivered at Jefferson Medical College, Philadelphia, by Wm. B. Atkinson, M.D. This lecture, upon a subject on which the books are almost completely silent, contains a careful study of the frame of the child in a healthy state, from its birth up to the time when it and its diseases may no longer be regarded as peculiar, but as coming under the heading of diseases of adult life. It treats of: The appearance and peculiarities of the infant at the moment of its birth; its rapid rate of growth; its weight; average weight of male and female infants; the skin and its color, and its vascular nature; the bones, their characteristics; the pulse of the new-born child; the respiration at different ages; the digestive system; the secretion of saliva and the period at which this occurs; the act of nursing; the state of the bowels, and the peculiarities of the urine; the early development of the child's senses; the breath, the tongue, the mouth, the lips, and the characters they should exhibit; the susceptibility of the infant to pain; the approach of first dentition; change of food; beginning of articulation; locomotion. SUPPLEMENT, No. **163.**

NOTES OF HOSPITAL AND PRIVATE Practice in San Francisco. By H. Gibbons, Sr., M.D. Brief Records of Observation and Experience during eighteen years of Hospital Practice, treating of Pulmonary Consumption; Cough and Night Sweats; Hemorrhage; Foods and Drinks for Consumptives; Malarial Diseases; Intermittents; Tenacity of Intermittent Fever; Typhoid Fever; Rheumatism and Neuralgia; Diseases of the heart, and Jaundice. SUPPLEMENT, **193.** The same number contains articles on appearance of the Tongue in Disease; Aural Therapeutics, and Treatment of Strychnia Poisoning by Chloral Hydrate, Apomorphia, and Electricity.

BURNS.—A CLINICAL LECTURE BY R. J. Levis, M.D. No class of injuries so often fatal as these. The varied character of Burns and their classification. The effects following applications of heat during different periods. Scald and its results. Effect of exposure to the sun's rays not to be classed with burns. The two urgent demands to which attention should be directed when the patient is brought in. Treatment of the pain and of the shock. How the clothes should be removed and the blisters treated. Subsequent local treatment of the burned surface. The Remedies to be employed. Treatment of extensive burns; how the dressings should be prepared, Carbolized oil, carbonate of soda, linseed oil and lime-water, carbonate of lead and oil. How mortification is to be treated. How visceral complications are to be guarded against. Structural changes that are to be aided by plastic surgery. SUPPLEMENT, No. **176.** The same number contains an interesting article on the "*Rashes that are Produced by Drugs in Daily Use.*"

COLD WATER IN TYPHOID.—BY J. W. Kibbee, M. D. An account of a peculiarly interesting case of typhoid and the author's method of treating it, and from the fortunate results of which he is led to the conclusion that all morbid phenomena attending fever of any name are directly due to excessive heat, and that the removal of the latter by water is a sure remedy. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **171.** Price 10 cents. To be had at this office, and from all newsdealers.

THE CARE OF YOUNG CHILDREN.—This paper is of special interest to parents and others who have young children in charge. It is full of practical and valuable advice, which followed will serve to prevent those diseases to which children are so liable in summer, and which are the causes of such great mortality among them. It points out the necessity of pure air for the child; what kind of food should be given and what kinds avoided; how various dietetic preparations are to be made; when and how the child should be weaned, how and when it should be bathed; and how it should be clothed; and the best kinds of food to select for the growing child. SUPPLEMENT, No. **192.**

BRONCHIAL ASTHMA.—A LECTURE delivered at the Medical Society of London, by Jno. C. Thorowgood, M. D., giving the author's views as to the causes, complications, effects of climate upon and the proper treatment of the disease, based on cases that have come under his own observation. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **171.** Price 10 cents. To be had at this office, and from all newsdealers.

TREATMENT OF ULCERS WITH A Saturated Solution of Chlorate of Potassium. By T. M. Rochester, M. D. Full Description of Treatment, with Explanation of Mode of Action of the Chlorate of Potash, and record of fourteen successful cases. SUPPLEMENT **155.** Together with Peroxide of Hydrogen in the Blood, Diarrhœa in Children, etc. Price 10 cents.

VASELINE IN PHARMACY.—BY Nathan Rosenwasser, Ph.G. Properties, Recommendations, and Uses of Vaseline, with Recipes for several Cerates and Ointments, as Vaseline Simple Cerate; Resin Cerate; Cerate of Extract of Cantharides, Pomatum Camphoratum; Ointment of Iodine, Citrine Ointment; Iodide of Iron Ointment; Ointment of Benzoin; Ointment of Iodide of Sulphur; Belladonna Ointment; Ointment of Nitrate of Silver. SUPPLEMENT **153.** With several other Chemical and Pharmaceutical Articles. Price 10 cents.

BILIOUS DISEASES.—WHAT ARE They, and why so Called? By J. H. Nowlin, M. D. Many Bilious Diseases, so called, in which the Liver is not involved. A Protest against Quack Treatment, etc., and an attempt to Correct a Grave Popular Conception. SUPPLEMENT **152.** Price 10 cents.

BALDNESS.—BY GEORGE H. ROHE, M. D. A brief but highly useful paper, showing the causes of Baldness, how Dandruff is produced, why the Hair falls off, with explanations of Kafoel's Prompt and Effectual Remedy and Recipe for the same; together with Directions and General Advice for Preventing Baldness, Restoring and Preserving the Hair. This is one of the most Useful, Practical, and Valuable Papers concerning the Treatment of Baldness ever published. Contained in SUPPLEMENT **161.** Price 10 cents.

PEROXIDE OF HYDROGEN IN THE Blood. By John Day, M.D. Paper read before the Medical Society of Victoria. An attempt to Explain the Action of certain common Remedies. Condition of Oxygen in the Blood, with interesting Chemical Experiments. Peroxide of Hydrogen in the Fats of the Blood. Importance of Fat in the Animal Economy. How the Coloring Matter of the Blood produces an Important Chemical Change. Therapeutic Effect of Fats and Oils, as Cod Liver Oil, Oil of Turpentine, common Resin, the Resin of Guaiacum, Myrrh, and Ether. SUPPLEMENT **155.** Together with Treatment of Ulcers with Clorate of Potassium, Diarrhœa in Children, etc. Price 10 cents.

LOSS OF HAIR.—BY JNO. V. SHOEMAKER, M.D. An excellent paper on a subject which is of interest and importance to every one. It points out the peculiarities and characteristics of the hair as found in a state of health in men, women, and children, and its variations according to climate and nationality, how and why it becomes thin and gray, or falls out, and the means that should be taken to prevent it; the proper attention that it deserves, the remedies that should be used in various diseased conditions; the cause of dandruff and its remedy, and advice as to the best lotions and washes to keep the hair and scalp in a healthy state. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **173.** Price 10 cents.

SOUND AND THE TELEPHONE.—BY Clarence J. Blake. A paper read before the British Society of Telegraph Engineers. The Human Hearing Apparatus. Acoustical Experiments with the Human Ear Apparatus. How to Make Sound Tracings. Delicacy of the Telephone Disk Movement. An Examination into the Conditions of Articulate Sound. Characteristic Curves for each Consonant, etc., etc. SUPPLEMENT No. **148.** Price 10 cents.

Domestic Economy, Agriculture, Horticulture, Etc. The Farm.

FARM LAW.—BY HON. EDMUND H. Bennett. This paper, which was read by the author before the State Board of Agriculture of Massachusetts, is full of important information regarding points of law not generally known, and with which not only farmers but every person in business should be acquainted. It tells how to buy a farm or other property, how the deed should be drawn, what constitutes farm boundaries, what a deed of a farm or property legally includes, what rights the owner has in the roadway, what the law is in regard to fences, the law as concerns the impounding of cattle, the farmer's liability for trespasses of his animals, the question of liability for and protection against dogs, the law in regard to water rights and drainage, what constitutes trespassing on the farm or property, the law in regard to the ownership of fruit hanging over the boundary line between two properties, or over roads. *About Hiring Help*—What the laborer is entitled to if no bargain is made, what he forfeits by leaving before his time expires, etc.; laws on the subject. *The Employer's Liability for his Men*—Illustrated by examples and with the legal aspects of each. *About Fires*—The liability of a hunter who fires a farmer's woods; the right of the farmer to burn brush, and how far he is responsible if fire is communicated to his neighbor's premises; how far he is liable to his neighbor for damages arising from fires through lightning or spontaneous combustion, the liability of railway companies for damages arising from fires communicated by locomotives. *Ways Over the Farm*—Various examples of right of way, and the laws on the subject. *Warranty of Seeds*—The two phases of the question that are of special interest to farmers and others, and their legal aspect. By making himself thoroughly familiar with the various law points which are carefully and fully considered in this paper, all farmers and property owners will be prepared to save himself thousands of dollars in the way of lawyers' fees and the expenses that often follow litigation. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **166** and **174.** Price 10 cents.

WHEAT CULTURE.—BY MR. GIBSON, of Indianapolis. Wheat Growing in Indiana. Benefits of Clover turned under. Probable advantage of Alkalies. Importance of Perfect Growth of Straw, and How to Obtain it. Burning the Straw on the Field. How to Treat Poor Clay Soils. Bone Dust, and its Astonishing Effect. Gypsum. Wheat Culture of New York and Maryland. Demonstrated Value of Analysis of Soils. Drainage. Selection of Seed. Average Production per acre. Amount of Seed per acre. Causes of Loss. SUPPLEMENT **155,** Together with Seeds and Seed-Planting. Price 10 cents.

A STUDY OF WHEAT. BY MRS. LOU Read Stowell, of the Microscopical Laboratory of the University of Michigan. An article of sterling and permanent value, not only to millers, for whom it was more especially written, but to microscopists and scientists generally; giving the botanical and natural history of wheat, an account of the weeds and parasites that infest it, and minute account of the microscopical structure of the plant as worked out by the author herself. Describes the cellular structure of the stem; its vascular bundles, spiral vessels, pitted vessels, parenchymatous cells, and its epidermis with stamata. The structure of the grains, its pericarp or three fruit coats, its two seed coats, its albumen, and its embryo. What is meant by the "bran." The hairs at the end of the grain, and the gas that fills their central cavity. The possibility that mill explosions may be due to the escape of this gas. The canals and spiral vessels that are found in their fruit coat. The coloring matter of the seed-coat and its influence on the color of the flour. Directions for those who desire to make microscopic examinations for themselves. The albumen—the part of the wheat that is of most interest to millers: its granular cells and walls of cellulose, and its starch cells. A diagrammatic view of the "bran" of wheat. Wheat grains as seen in cross-section. The microscopic appearance of starch of wheat, the composition, mode of formation, and characteristics of wheat and other starch. The text of this very instructive paper is illustrated with 14 engravings after figures drawn by the author from the microscope. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **159, 172, 178.** Price 10 cents.

THE CULTIVATION OF MUSHROOMS. One of the most comprehensive papers ever published on the subject of the artificial cultivation of this esculent; giving an interesting account of the celebrated Mushroom Caves of Paris, their daily production, and the estimated value of the harvest; describing the edible Mushroom or "Champignon" both as regards its external appearance and its internal structure; showing how the mushroom spawn is to be obtained, how the materials are to be prepared, how the beds must be made and the spawn planted; telling what additional care and precautions are necessary after planting the spawn; pointing out the various places where Mushrooms may be successfully raised, such as on shelves, in tubs, and in the floor of cellars, on shelves in stables, in special beds, or in melon frames in the open air, etc. Directions for gathering the crop. What other species of fungi are occasionally cultivated. Some of the Mushrooms that are eaten in Russia. How the Mushroom is cultivated in Japan. By following the exceedingly simple directions given in the article, any one may provide himself with Mushrooms for his table all the year round, and at but trifling expense, or engage in the profitable occupation of supplying the market with this delicacy. Illustrated with 8 engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, **178.** Price 10 cents.

THE PHYLLOXERA. THE COMPLETE Life History of this curious and destructive insect, as worked out by Prof. C. V. Riley in America and M. Balbiana in France. Illustrated with 10 engravings, showing all the phases of the insect from the egg to the perfect animal. The two types—Radicola and Gallæcola—of the Phylloxera. The Vine Phylloxera a polymorphic species. The sedentary females which live on the roots of the vine; their immense numbers, and their subterranean travels from one vine to another. The change of certain sedentary females into winged, migratory females. The deposition of eggs by the latter on the aerial parts of the vine. The sexed individuals that are hatched from these eggs. These individuals wingless and short lived; they do not eat, but occupy themselves solely with reproduction. The female lays but a single egg, then dies. The agamic wingless female issuing from this egg again begins the cycle of phylloxeric life. The problem to be solved in preventing an invasion of the pest is to destroy the winter egg. The minute size of the latter and the different methods that have been devised to discover and destroy it. Recipe for an approved insecticide, and how it is to be used. Resumé of the life of the Phylloxera, by Prof. Riley. SUPPLEMENT, No. **167.** Price 10 cents.

THE CATALPA TREE FOR ECONOMIC Planting.—By C. S. Sargent. Usefulness and Wonderful Durability of the Wood. The Catalpa for Railway Ties. Rapid Growing, and Freedom from Insects. SUPPLEMENT **132.** Price 10 cents.

HOW TO BUILD A GREENHOUSE.—Directions and Dimensions, with eleven figures. SUPPLEMENT **141.** Price 10 cents.

GRAPE CULTURE UNDER GLASS.—BY John Don, Foreman to Peter Henderson. Protection of the Roots; Pruning; Destroying Insects; Giving Air; to Counteract Drought, and all other Directions. SUPPLEMENT **110.** Price 10 cents. In the same number are articles on California Oaks in California; Asparagus Forcing in Paris; Hybridization of the Monukka and Black Hamburgh Grapes; Strawberries; California Oaks.

PLOWS OF ALL NATIONS.—AGRICULtural Implements at French Exhibition from China, Spain, Italy, Denmark, Malaisia, and the colonies of Holland, with nine figures. The display of England, France, and the United States. Wheeled Plows. Comparative Merits of English, French, and American Plows. SUPPLEMENTS **135, 141.** Ten cents each.

ARTIFICIAL INCUBATION.—DESCRIPtion of a very successful apparatus, which any one can make; 3 illustrations, with temperatures and directions. SUPPLEMENT **54.** Price 10 cents.

CHEAP GREENHOUSES AND HOW TO Heat Them.—By Peter Henderson. How to obtain Perfect Draft. Excellent Plan for Furnace Construction, etc., with two illustrations. SUPPLEMENT **82.** Price 10 cents.

CULTURE OF THE RASPBERRY.—A paper compiled by Abel F. Stevens, giving a short history of the fruit; describing the species which are cultivated; telling how the soil should be prepared, the vines planted and pruned and protected in winter, followed by a description of the varieties best suited to climates like that of New England SUPPLEMENT, No. **192.**

CULTIVATION OF MEDICINAL PLANTS at Hitchin, England.—By E. M. Holmes, F.R.S. Full and Practical Directions for Cultivation of Lavender. A Disease of the Plant described. How to Plant and Propagate; When to Harvest; How to Distil the Oils. Directions for Cultivation of Belladonna, Hemlock, Squirting Cucumber, and Henbane. Making Scammony Resin from the Root. SUPPLEMENT **107.** Price 10 cents.

GARDENS.—BY PETER HENDERSON. Instructions for the Cultivation of Rhubarb, Asparagus, Cauliflower, Cabbage, Lettuce, Tomatoes, Peas, Beans, Beets, Onions, etc.; Grapes, Strawberries, Raspberries, Blackberries, Currants, Gooseberries, etc. SUPPLEMENT **134.** With articles on Dynamite in Agriculture, Fodder, Corn, etc. Price 10 cents.

TRAINED FRUIT TREES.—TWENTYeight Pleasing Methods of Training at Paris Exhibition, each illustrated. How to get the Most Enjoyment out of Gardening. How to Cover Unsightly Walls, etc. SUPPLEMENT **132.** Price 10 cents.

CHEMISTRY OF THE POTATO—VALUE of the Potato to the Starch Manufacturer and the Stock Raiser. Testing Potatoes. Best Method of Cooking, etc. Several other Chemical Essays, as the Alkaline and Boracic Lakes of California, Determination of Ammonia, the Action of Sea Water on Lead and Copper, Proceedings of Chemical Societies, etc. SUPPLEMENT **79.** Price 10 cents.

FIG CULTURE AT THE NORTH—A paper of interest to all fruit culturists, pointing out the fact that the Fig, although a tropical fruit, can be successfully grown in the Northern and Middle States; that no crop will give so certain and so large returns as this, and giving practical directions for planting, pruning, protecting, drying the fruit, and other information in regard to the subject SUPPLEMENT, **171.** Price 10 cents.

NOTES ON TOBACCO—BY W. K. Glover. An interesting history of "the weed" in a condensed form, and treated under the following headings: Botanical Origin and Description. Cultivation. History. Consumption. Revenue Manufacture, etc. Process of making Cavendish, Roll Tobacco, Cigars, and Snuff. Tobacco-leaf Adulterations. Application in Medicine. Chemical Composition. Use and Abuse. SUPPLEMENT, No. **196.** Price 10 cents.

PRUNING OF NEWLY-SET FRUIT Trees, with Careful Instructions for Cutting Back, etc., with 3 illustrations. Additional information on new vegetables, Orchard Culture, etc. SUPPLEMENT **109.** Price 10 cents.

THE PEACH TREE: HOW TO PRUNE Properly.—By Prof. S. T. Maynard, with two illustrations. SUPPLEMENT **29.** Price 10 cents.

CRANBERRY CULTURE.—BY A. K. Gile, Me. Improved Methods of Harvesting, Cleaning, Drying, and Sorting Cranberries, securing the berries in Better Condition and at much less cost than by the old method. Most Favorable Soil and How to Plant. With excellent suggestions on keeping Eggs, the Cranberry as a Pot Plant, etc. SUPPLEMENT **101.** Price 10 cents.

CULTIVATION OF PEANUTS.—WHERE the Peanut is Cultivated; the Soil most favorable Dressing; Manure; Kinds of Peanuts, etc. How to raise a successful crop. SUPPLEMENT **97.** Price 10 cents.

SMALL GREENHOUSES. DESCRIPTION Of Several Greenhouses, with Cost, Modes of Heating, Ventilation, etc., with some Improvements. SUPPLEMENT **150.** Also, Plant Feeding, a Model Farm in Normandy, French Forestry Experiments, and Rain Water Cisterns. Price 10 cents.

OUTWARD MARKS OF A GOOD COW. By Capt. John C. Morris, Pa. Carelessness in Breeding. How to Select for Breeding. Marks of the Handsome Cow. Care and Training of the Heifer. Infallible Marks of Good Milkers. Distinguishing Marks and Characteristics of the "Bastard" and the "Bogus" Cow, etc. Contained, with useful Remarks on Bee Culture, in SUPPLEMENT **135.** Price 10 cents.

POINTS OF A GOOD HORSE.—BEING the Report of the Committee appointed by the New England Agricultural Society to decide upon Rules for Guidance of Judges of Horses. The Points of Excellence. Size, Color, Symmetry of Body, Head and Neck, Eye and Ear, Feet and Limbs, fully described. Speed at the Trot and in Walking, Style and Action, etc., with the percentage allowed for each quality. The Standard, Size and Speed for Matched Carriage Horses. Gents' Driving Horses, Family Horses, Park or Phaeton Horses, etc. An excellent Guide in selecting animals. SUPPLEMENT **103.** Price 10 cents.

ON THE CARE OF HORSES.—BY PROF. Pritchard, R.V.S. Showing the Proper Construction of Stables. Best Floor. Lighting and Ventilation. Hay-racks. Watering and Feeding. Grooming and Exercise. Cracked Heels; Lice; Colic; Mud Fever; Wind Galls. Also, in same number, facts about improved Cow Stables. How to keep Cows clean and maintain Pure Air in Stables. Increased Cleanliness and Convenience with Less Labor. Contained in SUPPLEMENT **123.** Price 10 cents.

THE PERFECT HORSE AND HOW TO Measure Him.—Being a description of the celebrated "Kentucky Prince," with table of measures, and an illustrative diagram showing the application of the System to any horse. SUPPLEMENT **29.** Price 10 cents.

PLOW EXHIBIT AT THE PARIS EXhibition. A comprehensive article, with 24 illustrations, describing a great variety of plows, many of them entirely new in this country. SUPPLEMENT **164.** Price 10 cents.

THE HORSE'S MOTIONS SCIENTIFIcally Considered, with 22 figures, showing the several positions of body and limb, assumed by the horse in walking and trotting. These engravings are made from instantaneous photographs, taken by an Automatic Electro-photographic Apparatus, giving truthful representations of the movements of the horse, which are at variance with the conventional idea. Contained in SUPPLEMENT **158.** Price 10 cents.

WHEELBARROWS AT PARIS EXHIBItion of 1878. Wheelbarrows for carboys, baggage, railroad stations, gardens; excavating, dumping, and tub barrows; wood trucks, sack trucks, stone trucks, pig-iron trucks, bloom-trucks; almost every conceivable form of wheelbarrow and hand truck. Shown in SUPPLEMENT **165.** Twenty-five engravings. Price 10 cents.

HORSE-SHOEING.—By D. E. SALMAN, D. V. M. In this paper, which is of great practical interest to every horse owner and horse-shoer, the author shows that horse-shoeing, as it has been hitherto practiced in this country, is responsible for a large proportion of the lamenesses with which our horses have been afflicted; and he points out, by a study of the physiology of the horse's foot, how shoeing should be properly performed and what errors should be avoided in the operation. SUPPLEMENT, No. **174.**

A HOME-MADE HORSE POWER.—BY William R. Brooks. Shows how any farmer, without the aid of a carpenter, may construct for himself with little trouble and but slight expense, a horse power machine capable of shelling corn, cutting feed, sawing wood, cleaning grain, pumping water, churning, and performing numerous other operations on the farm. Minute directions, illustrated with two engravings. SUPPLEMENT, No. **190.**

THE HORSE.—HIS QUALITIES AS shown by his limbs. By Richard Hugh Hilhouse. An article of great interest to all horse owners, showing by means of diagrams the correct pose, and the faults of position, so frequently met with in combination in one and the same horse. By means of the key here given, misshaped legs, misplaced feet, or bad action will be noted, and either counteracted or wholly avoided when mating since these deviations are the source of blemish and inflammation at the weakest points, and depreciate the value of the horse. SUPPLEMENT, No. **195.**

ICE-HOUSE AND REFRIGERATOR.—Directions and Dimensions for construction, with one illustration of cold house for preserving fruit from season to season. The air is kept dry and pure throughout the year at a temperature of 34° to 36°. SUPPLEMENT **116.** Price 10 cents.

ICE-HOUSE AND COLD ROOM.—BY R. G. Hatfield. With directions for construction. Four engravings. SUPPLEMENT **59.** Price 10 cents.

ICE AND ICE-HOUSES—HOW TO MAKE ice ponds; amount of ice required, etc., and full directions for building ice-house, with illustrated plan. SUPPLEMENT **55.** Price 10 cents.

These papers may be had at THE SCIENTIFIC AMERICAN Office, New York, or may be ordered through any Bookseller or Newsdealers. In ordering, please be particular to specify **the Number** of the Supplement that contains the paper desired. Promptly sent by mail to any part of the world. Price Ten Cents each Number.

Domestic Economy, Agriculture, Horticulture, Etc. The Farm.

FOOD PRODUCTS OF THE PARIS EXhibition. Soups and Tablets, Soup Balls, Dried Vegetables, Prepared Beans, Crystallized and Dried Fruits, Dried Apple Sauce, Dried Eggs, Gelatines, French Confectionary, Nougat, Pure Licorice, Coffee Substitutes, Sugar Coffee, Chocolate. SUPPLEMENT **151.** Price 10 cents.

HOUSEHOLD ORNAMENTS.—BY GEO. M. Hopkins. A paper containing directions for the easy manufacture of a great variety of beautiful objects for the adornment of the parlor and the home, of wood, but finished in imitation of bronze ware, including vases, urns, medallions, card receivers, brackets, match safes, picture frames, and hundreds of other articles. With 6 illustrations. SUPPLEMENT **7.** Price 10 cents.

CHEAP HOUSEHOLD ORNAMENTS.—By Geo. M. Hopkins. Practical Directions, with 13 illustrations, for making numerous Ornamental Objects with the simplest Tools and Materials. SUPPLEMENT **112.** Price 10 cents.

Fish Culture.

A SHORT BIOGRAPHY OF THE MENHADEN.—By Prof. G. Browne Goode, U. S. Fish Commissioner. A paper read before the American Association for the Advancement of Science, August, 1879. An essay full of interest not only to the scientist but to the general reader. The fish here treated of is known under at least 30 popular names in this country, and is of great industrial importance, not only for the oil which it yields, but also as a food, being used as such in either a fresh or salted state, or in oil under the name of "shadines." The habits of the fish are somewhat anomalous, and very little has hitherto been known or written about them. Contained in SCIENTIFIC AMERICAN SUPPLEMENT. No **194**, Price 10 cents.

Useful Recipes.

CEMENTS.—RECIPES SELENTIC, Martin's, Keene's, Parian, Hydraulic, Portland, Sal Ammoniac, Shellac, Venice Cements, and Mastic, Malin Stone; Artificial Stone, and Insoluble Glue; with Description and Uses of Lime, Gypsum, Red Lead, etc. SUPPLEMENT **133.** Price 10 cents.

USEFUL RECIPES FOR THE CONFECtioner, the Baker, and the Cook.—By J. W. Parkinson. Cream Cake, Doughnuts, Crumpets, Biscuit, Kisses. Apples a la Turque. Mead. Glair of Eggs. Ratafia de Framboises, Ratafia de Cerises, Raspberry and Currant Paste. To Color Sugar Sand. Cheese Cake. Cocoanut Macaroons. Orange Slices. Ice Cream, Fruit Ices, Iced Souffle. Lady Fingers. White Bride Cake, Sugar for Crystal Work. Scolloped Clams. To Restore the Fragance of Oil of Lemons. Family Bread. Contained in SUPPLEMENT **136.** Price 10 cents.

FIFTY SIRUP RECIPES FOR HOUSEhold purposes, Mineral Waters, etc., to wit: Simple Sirup, (2) Lemon Sirup, Mulberry Sirup, Vanilla Sirup, Vanilla Cream Sirup, (2) Cream Sirup, Ginger Sirup, Orange Sirup, (2) Pineapple Sirup, Nectar Sirup, Sherbet Sirup, Grape Sirup, Banana Sirup, (2) Coffee Sirup, Wild Cherry Sirup, Wintergreen Sirup, (2) Sarsaparilla Sirup, Maple Sirup, (2) Chocolate Sirup, Coffee Cream Sirup, Ambrosia Sirup, Hock and Claret Sirup, Solferino Sirup, Capsicum Sirup, Cherry Sirup, Strawberry Sirup, (2) Raspberry Sirup, Peach Sirup, Blackberry Sirup, Orgeat Sirup, Catawba Sirup, Milk Punch Sirup, Champagne Sirup, Sherry Cobbler Sirup, Excelsior Sirup, Fancy Sirup, Currant Sirup, Framboise Sirup, Maidenhair Sirup, Orange Flower Sirup, Cinnamon Sirup. How to make Sirups Frothy.

Colognes for the Sick Room, by Geo. Leis. With recipes for the production of preparations that serve as pleasing perfumes, deodorizers, and cosmetic lotions. SUPPLEMENT **77.** Price 10 cents.

PERFUMERY.—BY W. A. SAUNDERS, Pharmacist.—A valuable and practical paper upon the preparation of Perfume Extracts. With formulæ for the preparation of the most prominent and popular Perfumes now on the market, directions for the preparation and compounding of the ingredients, etc. The Formulæ here given embrace the preparation of the following Perfumes: Jockey Club, Moss Rose, White Rose, Victoria, Ess. Bouquet, Musk, Patchouly, Millefleur, Ylang Ylang, Spring Flowers, Wood Violets, West End, Tuberose, Stephanotis, Rondeletia, New Mown Hay, Frangipanni, Clove Pink, Violet, Mignonette. SUPPLEMENT **65.** Price 10 cents.

WATERPROOFING PAPER.—DESCRIPtion of Three Processes of Waterproofing Paper and Ligneous Tissues. By Daniel Felton, Manchester, England. SUPPLEMENT **96.** Price 10 cents.

SUMMER BEVERAGES.—A COLLECtion of over forty choice and valuable recipes for making various delicious summer beverages for domestic or restaurant use. The list embraces formulas for making Lemonade, Orangeade, Currant Water, Raspberry Water, Cherry Water, Soda Negus, Raspberry, Vinegar, Champagne a la Minute, Ice Tea or Coffee, Orgeat Beverage, Holland Beverage, Imitation Arrack Punch, Spanish Beverage, Persian Beverage, German Beverage, Claret Beverage, Narranada, English Rumfustian, Winter or Summer, West India Tippies, Imperial Beverage, Milk Punch, Brandy Punch, Regent's Punch, Claret Punch, Prince Regent's Punch, Bishop, Heidelberg Bishop, Princes' Punch, Cocoanut Beverage, Turkish Beverage, Ice Coffee Beverage, Claret Beverage, Sherry Beverage, Gin Punch, Sherry Cobbler, Mint Julep, Mead or Honey Wine, West India Shrub. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **192.** Price 10 cents.

CONFECTIONERY AT HOME.—BY Catherine Owen. Plain and practical directions for making a number of fine French candies; the only apparatus needed to obtain perfect results being a brass saucepan, and a silver spoon and fork. This valuable collection embraces recipes for making Fondants, Panache Fondants, Chocolate Creams, Orange and Lemon Creams, and Roman Punch Drops. SUPPLEMENT, No. **199.**

MISCELLANEOUS USEFUL RECIPES.—A collection of about 40 valuable recipes for the Household, Workshop, and Laboratory. How to make Skeleton Leaves. How to Preserve Autumn Leaves. How to make Smooth and Rough Academy Boards. Fumigating Paper. Recipes for Soluble Blue, Paste for Scrap Books, Rabbitt Metal, and Fusible Metal. Phosphorescent Paint for Clock Dials, etc. How to make Gelatine Moulds for Plaster Casts. How to Weld Horn. Recipes for Staining Horn Different Colors. Walnut Stain. How to Render Cloth Fireproof and Waterproof. Moth and Roach Exterminator. To Color Butter. To Remove Stains from Marble. To Remove Mustiness from Casks. How to Make Sticky Fly Paper. Chemical Novelties. Recipe for Ivorite or Artificial Ivory. Artificial Fuel. New Colors. Colors from Cocoa. Method of Preparing the Dyestuff "Morine." A new Mineral Gum, a Substitute for Gum Arabic. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **159.** The same number contains a valuable recipe for making a Superior Gum, and Directions for Keeping Fruit. Price 10 cents.

JELLIES, JAMS, AND PRESERVES.—A valuable collection of approved recipes for making the following articles: Apple Jelly, Crab Apple Jelly, Quince Jelly, Raspberry Jelly, White Currant Jelly, Peach Jelly, Red Currant Jelly, Cherry Jelly, Gooseberry Jelly, Peach Marmalade, Raspberry Marmalade, Blackberry Marmalade, Quince Marmalade, Quince Cheese, Rhubarb and Orange Marmalade, Strawberry Marmalade and Jam. How to preserve Quinces, Apples, Crab Apples, Muskmelon, Cherries, Orange Peel, Lemon Peel, and Pine Apples. SUPPLEMENT, No. **196.**

ARTIFICIAL FRUIT ESSENCES—FORmulæ for making the following fruit essences for the use of Confectioners, Soda Water Vendors, etc. Essence of Apple, Pear, Cherry, Black Cherry, Peach, Apricot, Plums, Grape, Currant, Strawberry, Raspberry, Pineapple, Melon, Orange, Lemon-Blackberry, and Nectarine. SUPPLEMENT, No. **196.**

100 CHOICE PRACTICAL RECEIPTS pertaining to matters of the Household, including various branches of Cookery. Invaluable to Housekeepers. Contained in SUPPLEMENT **164.** Price 10 cents.

CEMENTS. VALUABLE RECEIPTS FOR a great variety of cements, applicable to all of the purposes of the Household and Shop, including Rubber Cement, Waterproof, Acid-proof, Fireproof, Aquarium, Hydraulic, and Battery Cements. Cement for paper boats, for metals, for china and glassware, for leather, rubber, and for cementing leather and rubber to metals, glass, etc. Cements for wood, stone, etc. SUPPLEMENT **158.** Price 10 cents.

HOW TO REMOVE STAINS AND Spots from Linen, Cotton, Woolens, and Silk. Being a table of Specific Directions, showing how to proceed in removing from each of the above kinds of goods any stains of the following character, to wit: Stains of Sugar, Glue, Blood, Albumen, Grease, Varnish, Oil, Paints, Stearine, Vegetable Colors, Red Wine, Fruit Stains, Red Ink, Alizarine Ink, Iron Rust, Ink made with Galls, Lime, Lye, Alkali Stains, Tannin, Green Nut Stains, Coal Tar Stains, Wagon Grease, Acid Stains, etc. By means of this valuable table of directions any person, by providing himself with a few simple chemicals, and using them as directed, may readily clean any species of the above goods, and if necessary set up a cleaning shop. This is one of the most convenient and valuable papers on the subject ever published. Contained in SUPPLEMENT **158**, Price 10 cents.

MISCELLANEOUS RECEIPTS.—INcluding Moth and Roach Exterminator. Waterproofing Cloth. Making Cloth Fireproof. Fumigating Paper. Coloring Butter. Phosphorescent Clock Dials. Academy Board, to Make. Staining and Welding Horn. Stains, to remove from Marble. Skeleton Leaves, to Make. Walnut Stain. Soluble Blue. To Relieve Casks of Mustiness. Fusible Metals. Babbitt Metal, etc. In SUPPLEMENT **159.** Price 10 cents.

INKS.—A COLLECTION OF UPWARDS of 50 valuable recipes for making Inks of all kinds and for every purpose. The list embraces: Writing Inks, such as Black Ink, Aniline Black Ink, Asiatic Black Ink; Arnold's Writing Fluid, Green Ink, Blue Ink, Red and Carmine Inks, White Ink; Indelible Inks for marking linen and other textile fabrics; Drawing and Illuminating Inks, such as Gold Ink, Silver Ink, Carbon Ink, India Ink, Drawing Ink; Marking Inks for marking packages of merchandise; Sympathetic Inks of all kinds and colors; Japan Ink; Ink Powders; Hausmann's Indestructible Ink; Close's Indestructible Ink; Shoemaker's Ink; Stencil Inks; Papyrograph Ink; Inks for writing on Zinc; Inks for writing on Silver; Ink Erasers. In these recipes, which have all been gathered from standard authorities, the materials given for making the inks are inexpensive and easily obtainable; the directions are free from technicalities and the manipulations are simple. This collection is invaluable. SUPPLEMENT, No. **157.** Price 10 cents.

CLEANSING TISSUES WITH MINERAL Oils.—By M. Zaengerle. Practical Directions for Cleansing White Silk, White Woolen Articles, Velvets, etc., Pure Wool Garments, and Woolen Articles of Deep Colors and Mixed Tissues. These useful instructions, with Practical Papers on Argol Substitute, Fixing Indigo on Tissues, etc. SUPPLEMENT **82.** Price 10 cents.

HOW TO MAKE RUBBER HAND Stamps.—Practical directions. SUPPLEMENT **83.** Price 10 cents.

Decorative Art.

ORNAMENTAL DESIGNS.—SUGGEStions in Floral Design, by F. E. Hulme, F.S.A. SUPPLEMENTS **15, 18, 34, 115.** Price 10 cents each.

Directions for Making Cheap and Elegant Household Ornaments. SUPPLEMENTS **7, 112.** Imitation of Inlaid Wood, with Practical Directions. SUPPLEMENT **10.** Price 10 cents each.

Marble Clock. SUPPLEMENT **36.** Clock in Carton-pierre. SUPPLEMENT **99.** Candlestick and Candelabra. SUPPLEMENT **69.** Vase, Clock, and Candelabrum, Style of Louis XIV. SUPPLEMENT **64.** Price 10 cents each.

Damascened Ornaments from a Shield. SUPPLEMENT **120.** Silver Lamp Pendant. SUPPLEMENT **45.** Antique Marble Vase. SUPPLEMENT **98.** Price 10 cents each.

Carved Panel Ornaments for Wood and Metal, for Stove Doors, etc. SUPPLEMENTS **36, 43, 50, 63, 81, 82.** Price 10 cents each.

Designs for Lamp-posts. SUPPLEMENTS **4, 44, 108.** Iron Window Grilles. SUPPLEMENTS **44, 60.** Iron Railings, Gates, and Balconies. SUPPLEMENTS **70, 91, 117.** Iron Stairs. SUPPLEMENT **60.** Price 10 cents each.

Stone Monument, with Railing. SUPPLEMENT **117.** Cement Ornaments. SUPPLEMENT **44.** Chimney-pieces. SUPPLEMENTS **51, 121.** Staircase, Jacobean Style. SUPPLEMENT **53.** Ceiling Ornaments in Carton-pierre, etc. SUPPLEMENTS **89, 106.** Ceiling of Boudoir, Painted. SUPPLEMENT **116.** Designs for Fresco Painting. SUPPLEMENT **102.** Price 10 cents each.

Marquetry Ornaments. SUPPLEMENTS **66, 89, 136.** Old German Carpet. SUPPLEMENT **93.** Tapestry, Painted and Woven. SUPPLEMENT **75.** Price 10 cents each.

Writing Table and Chairs. SUPPLEMENT **43.** Inlaid Card Table. SUPPLEMENT **31.** Bronze Flower-pot stand. SUPPLEMENT **55.** The Table as an Object of Art, with 12 illustrations of the several styles. SUPPLEMENT **58.** Carved Buffets. SUPPLEMENTS **67, 123.** Chairs. SUPPLEMENTS **83, 92.** Table, Style of Louis XIV. SUPPLEMENT **74.** Upright Piano. SUPPLEMENT **100.** Harp. SUPPLEMENT **101.** Price 10 cents each.

Sixteen Designs of Majolica Tiles. SUPPLEMENT **107.** Ornamental Designs for Scissors, Knives, and Forks. SUPPLEMENT **77.** Gimmal Finger-Rings. SUPPLEMENT **43.** Modern Italian and French Jewelry. SUPPLEMENT **104.** Coffee-pot of Oxidized Silver. SUPPLEMENT **79.** Book Covers. SUPPLEMENT **91, 128.** Price 10 cents each.

Fence and House Trimmings, 29 Designs. SUPPLEMENT **68.** Price 10 cents.

From one to three large Engravings, with a Description accompanying each of the above designs, the whole series being illustrated by about one hundred and sixty engravings. The designs are chosen from Modern, Mediæval, and Ancient Sources; from Germany, France, and Italy, and illustrate all the leading Styles of Ornamental Art. Price 10 cents for each number.

Drawing.

AIDS TO DRAWING.—A VALUABLE Paper containing: (1) Engravings and Descriptions of the Construction and Use of the PANTAGRAPH, for Accurately and Quickly Copying Drawings, Photographs, Maps, Diagrams, etc., making the Copies larger or smaller or of the same size of the original. Any intelligent person may construct and use the Pantagraph by following the directions here given. (2) Also, Drawings and Description for the Construction of the CAMERA LUCIDA, a simple and valuable little instrument for making drawings direct from the object, and in Copying, Enlarging, or Diminishing Drawings, Photographs, etc. (3) Also, Drawings and Description of the CAMERA OBSCURA, a simple, effective, and cheaply made little instrument, by which Landscapes, Dwellings, and other objects may be easily drawn by any person with accuracy, although unskilled in drawing. (4) Also, THE SKETCHING FRAME, with Drawings and Descriptions for Construction and Use. A handy contrivance for ladies and others for assistance in outdoor drawing, portraiture, etc. (5) Also, THE REFLECTING DRAWING BOARD. A simple device in which the reflection from a pane of glass is made to throw down upon paper an image of the drawing to be copied; all the operator has to do being to draw the outline before him. (6) Also, THE TRANSPARENT DRAWING TABLE, showing how to construct a drawing board in which the light is thrown under and upward through the drawing, thus greatly facilitating the making of copies of any drawing. (7) Also, THE PROPORTIONAL DIVIDERS; being a simple instrument for enlarging or reducing drawings from one scale to another with Accuracy and Rapidity. (8) Also, THE PERSPECTIVE RULER. A simple device for the Correct and Rapid Drawing of the Perspective Lines in Drawing. The construction of all these various instruments is illustrated with engravings, and accompanied by plain, simple directions to enable any person at a small cost to make and use them. This is the most Valuable Paper of the kind ever published. The whole contained in SUPPLEMENT **158.** Price 10 cents.

MECHANICAL DRAWING.—BY PROF. C. W. MacCord, of the Stevens Institute of Technology. A series of new, original, and practical lessons in Mechanical Drawing, accompanied by carefully prepared examples for practice, with directions, all of simple and plain character, intended to enable any person, young or old, skilled or unskilled, to acquire the art of drawing. No expensive instruments are involved. Any person with slate or paper may rapidly learn. The series embodies the most abundant illustrations for all descriptions of drawing, and forms *the most valuable treatise upon the subject ever published, as well as the cheapest.* The series is illustrated by upward of 450 special engravings, and forms a large quarto book of over one hundred pages, uniform in size with the SCIENTIFIC AMERICAN. Price, stitched in paper, $2.50. Bound in handsome stiff covers, $3.50. Sent by mail to any address on receipt of price. Address Munn & Co., Publishers, 37 Park Row, New York. Office of the SCIENTIFIC AMERICAN.

For the convenience of those who do not wish to purchase the entire series at once, we would state that these valuable Lessons in Mechanical Drawing may also be had in the separate numbers of SUPPLEMENT, at 10 cents each. By ordering one or more numbers at a time, the learner in drawing may supply himself with fresh instructions as fast as his practice requires. These lessons are published successively in SCIENTIFIC AMERICAN SUPPLEMENTS **1, 2, 3, 4, 6, 8, 9, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 56, 58, 60, 62, 65, 69, 74, 78, 84, 91, 94, 100, 101, 105, 106, 107, 108, 134, 141, 174, 176, 178.**

ON THE PROGRESS OF AERONAUTICS. —An essay read before the Aeronautical Society of Great Britain by Frederick W. Brearey, Secretary of the Association. A useful and interesting paper. Containing brief accounts of the most recent trials of balloons having mechanical propelling attachments. The required dimensions and best forms for balloons with propelling machinery. Calculations of the power exerted by birds in traveling through the air, and their methods of action. Calculations of the mechanical requisites for successful aerial navigation, as indicated by the flight of birds. Report of balloon trials having vertical screw propellers, made by the British War Office. Air navigation by "pushing" balloons. Experimental trials of the Society's apparatus for testing the Lifting Power of plane surfaces when exposed to wind currents. Description and dimensions of Moys' steam Aerial Locomotive, with an account of its practical trial at the Crystal Palace. Description of Moys' remarkable self-lifting steam engine and boiler, of one horse power, but weighing only thirteen pounds, with dimensions, arrangement of the lifting fans, etc. SUPPLEMENT **50.** Price 10 cents.

HOW TO DRAW A STRAIGHT LINE.— By A. B. Kempe, B.A. With 33 engravings. An important essay on the several mechanisms for drawing Mathematically Straight Lines. Directions for making simple Home-made Instruments for this purpose; Beautiful Mathematical Problems; Geometrical Principles Involved; and full Description of all the most successful apparatus. SUPPLEMENTS **84, 85, 86, 87.** Price 10 cents each.

Miscellaneous.

SPRING MOTORS.—A SERIES OF VALuable papers illustrating the latest methods of applying springs for the propulsion of street cars and light road carriages. With plans and drawings of methods of construction and winding of the springs, length and power of springs, resistances, etc. Illustrations and descriptions of methods for driving sewing machines and other light machinery by spring power. SUPPLEMENTS **46, 47, 48, 50.** Price 10 cents each. Forty cents for the series.

VELOCIPEDE CARRIAGES OF LIGHT Construction.—Fast speed. Worked by hand cranks, also by foot treadles. SUPPLEMENT **8.** Price 10 cents.

PARIS EXHIBITION PRIZES, 1878. Full Official List of the Awards in the American Department, enumerating Exhibits and Names and Addresses of Exhibitors, with kind of Prize awarded in each case. Contained in SUPPLEMENTS **149, 150.** Price 10 cents each.

THE IDENTITY OF THE LINES OF Oxygen, with Bright Solar Lines, as shown in Photographs taken with Increased Dispersion. A paper read by Prof. Henry Draper, before the American Association for the Advancement of Science. SUPPLEMENT **194.** Price 10 cents.

SCIENTIFIC AMERICAN SUPPLEMENT. Any desired back number of the SCIENTIFIC AMERICAN SUPPLEMENT can be had at this office for 10 cents.

INVALIDITY OF STATE LAWS CONcerning the Sale of Patents.—All laws of State Legislatures that in any manner interfere with the free sale of Patent rights, such as the requiring of the agent or patentee to file copies of patent, take licenses, procure certificates, comply with forms, or which release the payee of ordinary notes of hand given for patents, have been declared unconstitutional and void by the United States Courts. All State judges, sheriffs or other State officials who undertake to interfere with patentees or their agents in the free sale of patents, make themselves liable to damages and other punishment. Decisions of the United States Courts on these points. SUPPLEMENT **25.** Price 10 cents.

VORTEX MOTION.—BY PROF. O. REYnolds.—A Lecture delivered at the Royal Institution. New Principle of Fluid Motion, and How Discovered. Characteristics of Smoke Rings. Eddies in Water, etc., and their Mathematical Relations. Nautical and other Applications, etc., with Beautiful Experiments. SUPPLEMENT **85.** Price 10 cents.

THE NEW GERMAN PATENT LAW.— Being the Full Text of the New Law for Patents, passed July 1st, 1877, covering all the States of the German Empire. SUPPLEMENT **80.** Price 10 cents.

THE POLICY OF PATENT LAWS.—BY Frederic H. Betts. An able paper read before the Social Science Association at Saratoga Springs, 1879, in which the author, after reviewing the history and nature of Patents, the objections that have been made to Patent Laws, and the alleged annoyances from them; and after showing the beneficial effects of Patents on prices, the benefits of Laws on the subject, and how Patents promote trade, urges that the teachings of experience pronounce that the Policy which has created, upheld, and liberalized Patent laws is just and sound, and ought not to be abandoned. Complete in Supplement, No. **197.** 10 cents.

THE SCIENTIFIC AMERICAN REFERence Book, a bound book of 144 pages for 25 cents. On receipt of 25 cents we send by mail, post-paid, a copy of a handsome little bound volume, entitled the SCIENTIFIC AMERICAN REFERENCE BOOK, containing 144 pages, illustrated with engravings, and forming one of the cheapest and most valuable books of condensed reference ever printed. Among its contents are:

1. *The Census of the United States*, by States, Territories, and Counties, *in full*, showing the area of the several States. *Also, Tables of Cities* having over 10,000 inhabitants. Compiled from the Census.

2. *Table of Occupations.*—Showing the principal occupations of the people of the United States, and the number of persons engaged in each occupation. Compiled from the last Census.

3. *The Patent Laws* of the United States in full, with Directions How to Obtain Patents, Official Rules, Costs, etc., Forms for Applications for Patents and Caveats, Directions How to Introduce and Sell Inventions, Forms for Assignment, in whole and part; Licenses, State, Town, County, and Shop Rights; Rights of Employer and Employes in respect to Inventions, State Laws concerning Patents; General Principles applicable to Infringements; Synopsis of the Patent Laws of Foreign Countries, Costs, Procedure.

4. *The Ornamental Design Patent Law* (full text).—Costs and Procedure for securing Design Patents for Ornamental Productions, such as Designs for Textile Fabrics, Patterns for Wood and Metal Work, New Shapes and Configurations of any article of Manufacture, Prints, Pictures, and Ornaments, to be printed, woven, stamped, cast, or otherwise applied upon machinery, tools, goods, fabrics, manufactures.

5. *The United States Trade-Mark Law* (full text).—With Directions, Proceedings, and Expenses for the Registration of Trade-Marks of every description.

6. *The Label Copyright Law* (full text).—With Directions, proceedings, and Cost of Registering Labels for Goods, Medicines, and Merchandise of all kinds.

7. *The General Copyright Law* of the United States (full text), for securing Copyrights on Books, Pamphlets, Charts, Maps, Photographs, Pictures, Engravings, Works of Art, etc. With Directions, Costs, etc.

8. *The Principal Mechanical Movements*, Described and Illustrated by 150 small diagrams, of great value to Inventors and Designers of Mechanism.

9. *The Modern Steam Engine.*—With Engravings showing all the parts, names, etc., and a brief history of the Invention and Progress of Steam Power.

10. *Horse Power.*—Simple and plain rules for Calculating the Horse Power of Steam Engines and Streams of Water.

11. *Knots.*—Presenting engraving of forty-eighs different kinds of Rope Knots, with explanations at to tying.

12. *Tables of Weights and Measures.*—Troy Weight; Apothecaries' Weight; Avoirdupois, or Commercial Weight; French Weights; United States Standard; Dry Measure; Land Measure; Cubic Measure; Liquid Measure; French Square Measure; French Cubic, or Solid Measure; Mensuring Land by Weight, with engraving of a section of the English and a section of the French rules, of equal lengths.

13. *Valuable Tables.*—1. Table of Velocity and Force of the Wind; 2. Table of the Specific Gravity and Weight per Cubic Foot and Cubic Inch of the principal substances used in the Arts; 3 Table of the Heat-Conducting Power of Various Metals and other Solids and Liquids, 4. Table of the Mineral Constituents absorbed or removed from the Soil, per acre by different crops; 5. Table of Steam Pressures and Temperatures; 6. Table of the Effects of Heat upon various bodies, melting points, etc.; 7. Table of the Heat and Electrical Conductivity of various metals.

14. *Geometry in Brief*, as Applied to Practical Purposes. With illustrations.

15. *Electrical Batteries and Magnets.*—Plain directions showing how any person may, at a cost of a few cents, make and put in operation an effective Electrical Battery, prepare and wind Electrical Magnets, make a Telegraph, and perform a variety of interesting electrical experiments.

16. *Interesting Illustrated Articles.*—1. The United States, its area, principal dimensions, length of coast, rivers, steam navigation, railways, telegraphs, with outline Map of the United states. 2. View of the Capitol at Washington, with dimensions and brief history. Views of the Patent Office, interior and exterior, dimensions and brief history. Views of prominent buildings and streets, New York and Washington. Distinguished American Inventors, with portraits of Franklin, Whitney, Fulton, Wood, Blanchard, Winans, McCormick, Goodyear, Morse, Howe, Lyall, Eads, with biographies and figures of their inventions.

17. *Miscellaneous Information.*—Force of Expansion by Heat; Small Steamboats. Proper Dimensions of Engines, Boilers, Propellers, Boats. Incubation, Temperature of. To Make Tracing Paper; Constituents of Various Substances; Friction, how produced, and Rules for Calculation; Specific Heat Explained; Specific Gravity of Liquids, Solids, Air, and Gases; Gunpowder—Pressure, Heat, and Horse Power of; Copying Ink, to make; Heat, its mechanical equivalent explained; Molecules of Matter, size and motion explained; Lightning and Lightning Rods—valuable information; Value of Drainage explained; Amount of Power at present Yielded from Coal by best Engines; Sound, its Velocity and Action; Liquid Glues. Recipes; Value of Brains; Properties of Charcoal; Height of Waves; Speed of Electric Spark, etc.; Valuable Recipes.

THE SCIENTIFIC AMERICAN REFERENCE BOOK, price only 25 cents, may be had of News Agents in all parts of the country, and of the undersigned. Sent by mail on receipt of the price.

All the above or any desired numbers of the SCIENTIFIC AMERICAN SUPPLEMENT can be obtained through any Newsdealer, or at this Office. Price 10 cents each. In ordering, please be particular to give the number of the SUPPLEMENT that contains the article desired.

Any desired number of the SCIENTIFIC AMERICAN SUPPLEMENT will be sent postpaid to any part of the world on receipt of 10 cents. Address MUNN & Co., New York.

MUNN & CO., Publishers,
No. 37 PARK ROW, NEW YORK.

These papers may be had at THE SCIENTIFIC AMERICAN Office, New York, or may be ordered through any Bookseller or Newsdealers. In ordering, please be particular to specify **the Number** of the Supplement that contains the paper desired. Promptly sent by mail to any part of the world. Price Ten Cents each Number.

Miscellaneous.

THE DRIVE WELL IN ENGLAND.—A Paper read before the Society of Eng., Lond., by Mr. Le Grand. Full Description of the Operations of Driving, and how all Contingencies are Met. The several Methods of Working. Details of all parts of the Apparatus and their Use, with fourteen figures. Purity and Cheapness of the Water Supply from Drive Wells; Usefulness of the Well in War. The Tube Well for Testing Land for Water or Foundations, and for Driving Iron Piles under Water. SUPPLEMENT **107.** Price 10 cents.

TUBE WELLS FOR LARGE WATER Supplies. By Robert Sutcliff. Read before the Society of Engineers, London. Favorable and Unfavorable Soils, Gravel, Chalk, Marls, Sand, Rocks, and Stones, and How to Deal with each. How Messrs. Allsopp & Sons obtain 60,000 gallons of water per hour from Tube Wells. Messrs. Bass & Co.; the Solway Hematite Iron Works; Messrs. Truman, Hanbury & Buxton's Brewery; Messrs. Warwick's Brewery; the Tunnel Portland Cement Co., all of England, and their water supply. Mode of Sinking. How to obtain Water from Fine Sand. Five figures. SUPPLEMENT **110.** Price 10 cents.

MINE ACCIDENTS, MECHANICAL AP-pliances for use in case of Explosions, etc. By Chas. Hawksley and Edward B. Marten. A paper read before the Institution of Mechanical Engineers. Eighteen illustrations of the most approved apparatus for quickly discharging water from mines, promptly restoring Ventilation, etc., namely: the Pulsometer, the Steam Ejector, the Centrifugal, and other Pumps, combined Boiler, Engine, and Air Compressor; Air Lock, and Portable Winding Gear. SUPPLEMENT **105.** Price 10 cents.

NEW UNITED STATES GOV'T RULES in respect to Boilers, Boiler Inspection, Stamping and Testing of Boiler Plates, Fire Apparatus, and Boat Lowering Devices and Life Preservers. Instructions to Inspectors, and Tests of Boiler Material are to be made and recorded. Requirements in Construction of Boilers. The Law in full, with List of approved Fire Extinguishing, Life Saving, and Boat-lowering Apparatus. SUPPLEMENT **113.** 10 cents.

BOILER INSPECTION. RULES OF THE English Board of Trade. Instructions to Surveyors. Working Pressure for Cylindrical Shells of Boilers. Conditions and Factors of Safety. Formula for Determination of Strength, etc. Also, CORROSION IN BOILERS. Report to the French Steam Boiler Commission, by M. Hanet Clery, on the corrosion of boilers by sulphuric acid deposited by smoke. Full and instructive accounts of several explosions. SUPPLEMENT **104.** Price 10 cents.

OFFICIAL SIGNAL RULES FOR VESsels.—Lights for Sea-going Steamers; for Towing Steamers; for steamers not sea-going; for Mississippi steamers; for sailing vessels. Steering Rules. Instructions in full for all vessels and boats; and what the law requires in their management, and their equipment of lights, signals, fog horns, etc. Also, Raising of the Vanguard; Prevention of Collisions at Sea; Improved Ship's Bridge; Life Boats, etc., etc. SUPPLEMENT **83.** Price 10 cents.

H. M. S. INFLEXIBLE.—LARGEST AND Strongest Ironclad Afloat. The Armor and the 80 ton Guns. Dimensions of the vessel, Rig, and Arrangement of Turrets. The Cellular Construction, Ventilating Apparatus, Boilers, Engines, Pumps, Weights, and Cost, with one illustration. Working of the Guns, and Armstrong's Hydraulic System for Turning the Turrets. SUPPLEMENT **132.** Price 10 cents.

STEEL ARMOR PLATES.—IMPORTANT Trials of Steel and Compound Steel-and-Iron Plates. Sir Joseph Whitworth's Plates. The Armor of the Inflexible. SUPPLEMENT **112.** Price 10 cents.

WIRE ROPES FOR SHIPS' CABLES.—By G. L. Ateey, A.J.N.A. Their Great Superiority to Chain Cables, in Security, Light Weight, Small Stowage, Facility in Handling, Value when Worn Out, etc., with the advantage that they can be used in Towing, and enable ships to carry an Anchor at the Stern. SUPPLEMENT **132.** Price 10 cents.

SUBMARINE FOUNDATIONS, BEING A Description, with dimensions and scale drawings of the apparatus employed at Polar Harbor, Austria. SUPPLEMENT **30.** Price 10 cents.

THE BALTIMORE WATERWORKS.—Particulars of a Tunnel Seven Miles Long Through Solid Rock. The New Stone Dam. The Old Water Supply and the New, with Three Profiles of the Aqueduct. SUPPLEMENT **135.** Price 10 cents.

CAST IRON BUILDING FRONTS AND their Decoration.—By J. P. Putnam. The strength, durability, non-combustibility, lightness, and economy of iron. Right and wrong modes of decoration. Iron combined with terra-cotta with excellent effect. SUPPLEMENT **100.** Price 10 cents.

SPECTRUM ANALYSIS. BY PROF. Redwood. A highly interesting lecture, recently delivered before the Pharmaceutical Society of Great Britain. Explaining the propagation of Light and the properties of Ether. Giving lengths of Light-waves and showing the cause of Refraction. The Theory of Color, and how the Spectrum is accounted for. The characteristic Spectra of the several Metals and the Method of Analyzing by the Spectrum. SUPPLEMENT **79.** Price 10 cents.

CHEMICAL REAGENTS, BY MALVERN W. Iles. Importance of Purity in Chemical Reagents. Enumeration of Impurities Detected in Ammonium Hydrate, Acetate, Carbonate, and Chloride; Ammonia Iron Alum; Ammonium Sulphate; Arsenic Salts; Barium Carbonate, Chloride, and Nitrate; Calcium Chloride; Chrome Alum; Hydrochloric Acid; Hydrodisodic Phosphate; Magnesium Sulphate; Nitric Acid; Plumbic Acetate; Mixium; Potassium Antimoniate, Oxalate, Hydrate, and Sulphate; Sodium Acetate; Stick Potassa; Sodium Carbonate; Sulphuric Acid; Sheet Zinc; with character of Impurities and Name of Manufacturer. SUPPLEMENT **98.** Price 10 cents.

ARTIFICIAL PRODUCTION OF HAIL-stones, Rain-drops, and Snow-flakes, for the purpose of studying their Formation.—Abstract of Paper read before the Manchester Literary and Philosophical Society, by Prof. Osborne Reynolds, F.R.S. Two Figures. SUPPLEMENT **118.** Price 10 cents. Also, in same number, the Divisibility of Gold, and Curious Facts in Gold Mining; Liquefaction of Hydrogen; Gallium, etc.

VEGETABLE COLORING MATTERS.—Experiments proving the necessity of light in developing the Colors of Plants. Chemical Character of the Coloring Matters. Causes of Autumnal Tints. Construction of the Color Cells, etc.; causes of Color in Flowers. SUPPLEMENT **76.** Price 10 cents.

NEW DISTILLATORY APPARATUS FOR Pharmaceutical Purposes, Recovering Alcohol, Making Fluid Extracts, etc.—By Joseph P. Remington. Description and One Cut of a Still that has

STATE INSANE ASYLUM OF NEW JERsey.—With Two Illustrations and Ground Plan. Detailed Description of one of the Best Constructed Public Institutions in the country, with particulars of the Best Apparatus and Methods in use for the Culinary Department, Ventilation and Warming, Lighting, and Laundry work. Also, Practical Experience in the Causes of Insanity, and Treatment. SUPPLEMENT **110.** Price 10 cents.

SIGHT.—THE INFLUENCE OF SCHOOL Life thereon.—By George Reuling, M.D. The alarming prevalence of short-sight among children, and causes thereof. Structure of the Eye, and How it is Injured. Important Practical Suggestions on Forms of Desks and Seats, Color of Walls, Illumination, Method of Instruction, etc., to prevent optical injury. Over, or Long Sight; its Cause and Prevention. SUPPLEMENT **67.** The same number contains valuable essays and remarks on the suspension of Sewer Particles in the Atmosphere; Treatment of Rheumatism; Croton Chloral in Whooping Cough; Safe Administration of Chloroform, etc. Price 10 cents.

HOW THE AIR PASSAGES ARE EXplored. By F. Seeger, M.D. Diagnosis of Disease of the Larynx, with Description and two figures of the Laryngoscope and the Rhinoscope, and Directions How to Use. The Wonders of the Vocal Organ and the Voice. SUPPLEMENT **108.** Price 10 cents. Also, in same number, Physiological Notes; Near-sightedness, etc.

ROTARY-LATERAL SPINAL CURVAture.—By Prof. Lewis A. Sayre. Lecture delivered at the Bellevue Hospital, N.Y. Pott's Disease. Dr. Banning's Method. Broadhurst's Apparatus, and others. Judson's Method. Philosophy of Spinal Curvature. Self-extension and its beneficial results as illustrated by several cases. SUPPLEMENT **111.** Price 10 cents.

CLUB-FOOT; SPINAL CURVATURE; Hip-joint Disease.—Lecture by Prof. L. A. Sayre at Bellevue Hospital, N. Y. Club-foot Treated by a New, Painless Method. Several Cases described, and Success in Treatment. Useful Suggestions for Adhesive Plaster. How to Detect Incipient Hip-joint Disease. How to Distinguish between Hip-joint Disease and Psoitis. Treatment. Also, Corrosive Sublimate in Dentistry, Mental Illusions, the Color of the Retina, Insanity in the United States, Treatment of Paralysis of the Eye Muscles, Antiseptic Dressings, Near-sightedness. SUPPLEMENT **122.** Price 10 cents.

TREATMENT OF THE DROWNED.—Simple Practical Directions, with engravings, showing how to manipulate the bodies of persons taken from the water, with a view to restore life by producing artificial breathing. These directions are approved by various Health Boards, and are of much value. SUPPLEMENT **201.** Price 10 cents.

DIGESTION AND DYSPEPSIA.—BY Charles Richet, M.D. An abstract of a recent important lecture by this eminent French physician; being the outcome of a remarkable discussion which has for some time past been going on among the Medical Societies of Paris. Among the questions discussed are: (1) The influence of the various alimentary substances upon the secretion of the Gastric Juice. (2) The influence of such substances upon the Secretion of Pepsin. (3) The digestibility of the various alimentary substances in daily use. The teachings and directions of Dr. Richet for the cure of dyspeptic troubles, as here presented, are simple, and are said to be attended by the happiest results. SUPPLEMENT **199.** Price 10 cents.

CONSUMPTION.—TUBERCULAR CAchexia.—By Charles G. Polk, M.D. An important and valuable paper, showing the nature, anatomy, and modes of origin of the above maladies. The most approved methods of diagnosis. The most promising and successful modes of treatment, including climates, diet. With accounts of the most approved Medical Treatment and Formulæ therefor. SUPPLEMENT **203.** Price 10 cents.

WAYS OF REMEMBERING.—BY J. Mortimer Granville, M.D. A very interesting and valuable paper upon the Memory. Showing how we Remember, and how the Memory may be steadily and surely Improved. Contained in SUPPLEMENT **203.** Price 10 cents.

HINTS TO YOUNG MACHINE-TENDers.—By an old Papermaker. Practical instructions for the tending and caring of Papermaking Machinery. Showing how to clean a Dandy; how to make good edges; to keep paper from crushing and worming; to stop crimping; together with many other valuable directions, hints, and suggestions. SUPPLEMENT **79.** Price 10 cents.

SPONTANEOUS COMBUSTION.—A paper read before the Society of Arts, London, by Chas W. Vincent, F.R.S. An able Exposition, clearly explaining the nature of Heat; how it is produced by disruption and by combustion; how spontaneous combustion results; effects of fermentation; spontaneous combustion of coal; spontaneous combustion on ships; how carbon spontaneously ignites; Faraday's Interesting Experiments. SUPPLEMENT **81.** Price 10 cents.

SIZING OF COTTON GOODS.—READ before the Society of Arts, by W. Thompson, F.R.S. A most Full and Clear Description of the Process, embracing: An account of the process of Weaving, explaining the object and utility of Size. A table of Sizing Mixtures, in which are enumerated the Substances used: 1, for giving Adhesive properties of Size; 2, to give Weight and Body to the Yarn; 3, for Softening Size or Yarn; and 4, for Preserving the Size from Mildew and Decomposition. Tests for these Substances, and Directions for Preparing, so as to obtain the results required. Proportions of Sizing. Use of Flour in Size. Weighting Materials, China Clay, and its substitutes. "Softenings," and Oils for Softening. East Winds and their effect. Glycerine, Grape Sugar, Mildew Preventives, and Tape Sizing. "Slashing," Packing, Damaged Goods, etc. SUPPLEMENT **80.** Price 10 cents.

JAPANESE ART MANUFACTURES.—By Christopher Dresser, Ph.D., etc. Paper read before Society of Arts. The Japanese Potter at Work. Curious mode of Making Scarfs. How the Japanese Print on Cloth. Japanese Process for Silk Ornamentation. Japanese Weaving. How Fine Japanese Fans are made. Japanese Method of Making Moulds for Ornamental Castings for Vessels. Bronzes, etc. Japanese Lacquer Manufacture. Curious Method of Decorating Lacquer Work. The Love and Pursuit of the Beautiful in Japan. A very entertaining, instructive, and comprehensive paper. SUPPLEMENT **115.** Price 10 cents.

EXPLOSIVE DUST.—A COMPREHENsive description of the Dangers from Dust in various Manufactures and the Cause of many Fires. How combustible substances can explode. Spontaneous Combustion of Iron, Charcoal, and Lampblack in Air. Flour Dust and Brewery Dust Explosions. Explosions of Coal Dust in Mines. SUPPLEMENT **135.** Price 10 cents.

HOW TO USE THE CARPENTER'S Square.—By John O'Connell, Millwright. Over 40 engravings. An excellent Practical Treatise on the many Mathematical and Geometrical uses of the common Square, and explaining the manner of using the various scales marked thereon. Also, directions how to find a circle equal in area to two given circles; to lay off an octagon in a square; to find the center of a circle with a square, and many additional problems. Also, the application of the Square to Roofing, Stair Building, etc. A valuable and useful paper. SUPPLEMENTS **88, 89.** Price 10 cents each; 20 cents for the two.

NEW PROCESS MILLING.—ITS ECONomy and General Adoption. Principle of the Process. Its Parallels in the Hungarian Process, and the Mouture Economique of France. "SUPPLEMENT

MAGNETISM.—PRACTICAL EXPERIments in Magnetism, with special reference to the Demagnetization of Watches. By Alfred M. Mayer: With 35 illustrations. A very interesting and valuable paper, full of useful information concerning Magnetism; embracing descriptions and instructions for the performance of a large number of highly interesting and instructive experiments, which any person may readily execute at home or elsewhere, with very little or no cost. Showing, among other things, the nature and operation of magnetism, the direction of magnetic lines, how to make and use magnets, how to magnetize and demagnetize iron and steel; the laws of magnetic induction, with various remarkable experiments; convenient experiments to prove the earth's magnetism; how watches become magnetized and their time-keeping qualities become thereby injured, and how, by means of a small magnet, any watch may be quickly demagnetized and restored to its original condition as a time-keeper. This is one of the most concise and practical papers on Magnetism ever published. The author is well known for his many original scientific investigations, and is at present Professor of Physics in the Stevens Institute. Contained in SUPPLEMENTS **206** and **207.** Price 10 cents each.

HOME-MADE TELESCOPE STANDS.—By T. D. Simonton. A valuable paper, descriptive of a simple, effective, and economical method of constructing an equatorial telescope stand. With three illustrations to scale. SUPPLEMENT **78.** Price 10 cents.

PAINTING, VARNISHING, AND CLEANing of Cars.—A recent discussion before the Master Car Painters' Association. Embracing a series of Practical Questions, with Answers thereto by Practical Painters, upon the above subject; equally applicable to the Painting and Varnishing of all kinds of Vehicles and other works where durable and superior finish is desired. In this paper is shown: (1) The best method of cleaning cars, inside and outside, preparatory to varnishing. (2) Which will wear longest, two coats of hard rubbing varnish and one of wearing body, or one coat of hard rubbing and two coats of wearing body? (3) The best size for gilding and working easily. (4) Varnishing of head linings. (5) The best drier and best mixture for head linings. (6) The best and most economical style or ornamentation for head linings. (7) The best method of painting and finishing a car body. (8) The most economical and durable color for outside cars. (9) The best mode of painting over old paint. All contained in SCIENTIFIC AMERICAN SUPPLEMENT **204.** Price 10 cents.

PAINT IN CONSTRUCTION. BY ROB'T Grimshaw, C.E. Peculiarities and Chemical Constitution of Paris White, White Lead, Zinc White, Baryta White, Blende, Antimony White, Iron Oxide, Red Led, Prussian Blue, Cobalt Blue, Smalt, Coal Tar, Soluble Glass, Yellow Ocher, Raw Sienna, Fuller's Earth, Lampblack, with Valuable Practical Hints. SUPPLEMENT **125.** Price 10 cents.

METHODS AND RULES FOR CHINA Painting.—A series of practical directions for the Ornamentation of Porcelain, Earthen, and Chinaware. Showing the requisite brushes, instruments, colors, and mode of operation; how to make and transfer patterns; how to succeed in producing good work. SUPPLEMENT **199.** Price 10 cents.

PROGRESS OF GAS MANUFACTURE. Presidential Address to North British Association of Gas Managers. History of Gas Lighting, and Progress in Retorts. The Hydraulic Main; Gas Condensers; Washers and Scrubbers; Gas Purification; Exhausters and Governors; Gas Holders; Mains and Service Pipes; Electric vs. Gas Lighting. SUPPLEMENT **140.** Price 10 cents.

ENGLISH BICYCLES: SPEED TWENTY miles per hour; 200 miles made in one day. Weight, 40 or 50 lbs. 8 illustrations. SUPPLEMENT **73.** Price 10 cents.

THE COAL TAR COLORS.—A LECTURE before the Society of Arts, by George Jarmain. Aniline, Toluidine, Magenta, their Manufacture. Chemical Reactions, etc., fully treated. Instructions and Recipes for Dyeing with the Aniline Crimson. Violet, Blues, Greens, Brown, Black, Yellow, Picric Acid, and Ponceau. Dyeing Mixed Fabrics of Cotton and Wool. Excellent suggestions to Dyers. SUPPLEMENT **68.** Price 10 cents.

DETECTION OF ALCOHOL WHEN used as an Adulterant of the Essential Oils.—By Edmund W. Davy, M.D. A New Test, with full Directions for Applying. SUPPLEMENT **95.** Price 10 cents.

PERFUMERY.—BY ALEX. B. LEVI, Ph.G. Being reliable formulæ for the production of the following Perfumes: Jasmin, Frangipanni, Essence Bouquet, Ylang Ylang, Geranium, Night Blooming Cereus, Heliotrope, Musk, White Rose, New Mown Hay, West End, Violet, Patchouli, Jockey Club, Millefleurs, Tuberose, Cologne Water. Contained in SUPPLEMENT **202.** Price 10 cents.

ACTION OF SEA-WATER ON LEAD and Copper.—A paper read before the Manchester Literary and Philosophical Society by Wm. H. Watson, F.C.S. Also numerous chemical notes. SUPPLEMENT **79.** Price 10 cents.

THE ENEMIES OF BOOKS. THEIR NATural History, their Ravages. How to Destroy Them. The Cockroach, the Deathwatch, the Weevil, the Tabby Moth, the Sugar Louse, the Brazilian Traça, and their Larvæ, described and illustrated with twelve figures. SUPPLEMENT **138.** Price 10 cents.

THE NORWEGIAN LEMMING AND ITS Migration.—By W. Duppa Crotch, F.L.S. A highly interesting Description of the animal, with an account of its astonishing periodical, Migrations westward into the Atlantic Ocean, whereby myriads of these creatures voluntarily drown. The Lemming on its travels; its numerous enemies, and its pugnacity. How it Lives in Winter under the Snow. Its Widespread Destructiveness. Probable Cause of these Suicidal Migrations. Singular Proof of the former existence of the sunken continent Atlantis. Also, in same SUPPLEMENT, the Intelligence of Ants, etc. SUPPLEMENT **75.** Price 10 cents.

THE GEOLOGICAL ANTIQUITY OF Flowers and Insects.—By J. E. Taylor, F.G.S. A plain, comprehensive review of the subject, bringing forward many instructive facts; with six illustrations. The invariable correlation between insects and flowers. How they are fossilized. Fossil Botany. Geological Evidences of Evolution. Correspondence in the succession of Animal and Vegetable life. Flowers necessary to Insects, and Insects necessary to Flowers. Insects and Plants in the Devonian, the Switzerland Lias, the English Stonefield Slate, the Tertiary Strata, the Coal Measures, a Greenland and other formations. A Peculiar Aspect of Evolution. SUPPLEMENT **120.** Price 10 cents.

EVIDENCES OF THE AGE OF ICE.—By Henry Woodward, F.R.S. An able and Instructive Essay, with five illustrations, enumerating the present climatic variations, the Geological and other Proofs of the Glacial Epoch. Description of the Age of Ice as still seen in Greenland and upon the Alps, etc. Migrations of Man and Animals during climatic changes. Astonishing Volcanic Disturbances, and their bearing on Temperature. SUPPLEMENT **76.** Price 10 cents.

STRAW FOR FODDER. BY PROF. G. C. Caldwell. Chemical Elements required by Animals. Relative Nutritive Value and Digestibility of various articles of Fodder. Oat Straw sometimes better than Meadow Hay. Improving Straw by Slight Fermentation. Also, Directions for Grafting and Laying Down Raspberries. SUPPLEMENT **122.**

ECONOMIC PLANTS IN JAMAICA.—Success of Coffee. Cocoa, Sugar Cane, Pineapples, Cocoanut. The Best Kinds and Best Methods of Cultivation. Useful Timber Trees. What has been done in raising Teak. Cultivation of Medicinal Plants. Cinchonia, Eucalyptus, Jalap. SUPPLEMENT **85.** Also, in same number, Potato Culture, Clover, Hone, Manufacture, Superphosphates, etc. Price 10 cents.

SUGGESTIONS TO THE FARMER AND the Grocer.—Eggs; Poultry Fertilizers; A Test of Potatoes; Detection of Watered Lard; Adulteration of Pepper; Green Hay; Calculus in Horses; How to Soften Hard Water; New Mash for Horses; Preservation of Butter, etc., with useful Household Hints. SUPPLEMENT **53.** Price 10 cents.

AGRICULTURAL SUGGESTIONS. POTash in Agriculture. Formulas for Fertilizers. Obligations to Commerce. Grape Culture. A Fruit Evaporator. How to Exterminate the White Daisy. Pork Raising. SUPPLEMENT **132.** Price 10 cents.

AGRICULTURAL SUGGESTIONS.—How to keep Stalled Cattle clean. A simple plan that obviates the necessity of cleaning them. One illustration. Hop Culture in New York. Cost of Raising Potatoes. Suggestions for Winter Strawberries. To Destroy Chicken Lice. Influence of Cold on Milk. Cheap Greenhouses. SUPPLEMENT **105.** Price 10 cents.

AGRICULTURAL AND HORTICULTUral Subjects.—Sussex Cattle, 1 fig. New Method of Preserving Fodder without barns. Two illustrations. Corn Storer and Hay. Birds and Gardens, with 1 fig. Barnyard Manure. Value of Cow Dung. Cotton Seed as Manure. Manurial Substances. The Tulip Tree. New Grapes. Fertilizers in Gardens. Lime Dust. Low-headed Trees. Liquid Grafting Wax. SUPPLEMENT **70.** Price 10 cents.

AGRICULTURAL AND STOCK RAISING Subjects. Kittatinny Blackberry.—By E. Williams. Cotswold Sheep, with one illustration. Movable Sheep Shelter, with one figure. Poison for Red Spider. Management of Turkeys. Subterranean Forests and Mesquite Thickets. The Tsetse. SUPPLEMENT **121.** Price 10 cents.

CULTIVATION OF POTATOES.—A REport of the results of a novel contest by members of the Franklin (Mass.) Farmers' Club to determine the Largest Quantity of Potatoes to be raised on a square rod of ground. The report gives the operations of ten different competitors, the kinds of fertilizers used, the mode of cultivation, how the bugs were managed, etc. The highest yield was at the rate of 488 bushels per acre. Contained in SUPPLEMENT **201.** Price 10 cents.

COVERED BARN YARD AND FARM Buildings.—Description and 4 illustrations of a Covered Homestead on a Norfolk (Eng.) Farm. Directions for Construction and Dimensions. Also How to Construct a Covered Barn Yard, with engraving, dimensions, etc. SUPPLEMENT **118.** Price 10 cents.

ABORTION IN COWS.—BY L. FRANK. Causes; Frosted and Blighted Food; Violent Movements; Lead, Aniline, and other Poisons; a Mysterious Infection, and Important Facts; Bacteria. SUPPLEMENT **132.** Price 10 cents.

PLOWS AT THE PARIS EXHIBITION. Plows and Ox-yokes of Java, Dutch East India, China, Spain, and Italy. The History of Plows. Interesting Remarks on the Agriculture of China, India, etc. SUPPLEMENT **135.**

LIGHTING BY ELECTRICITY. BY Robert Briggs, C.E. The Lamps, Magneto-electric Machines, and other apparatus now used at the Railway Station at La Chapelle, Paris. Practical Running and Cost of the system; Perfect Illumination at half the cost of Gas, and other advantages. Pixii's, Saxton's, Clarke's, Siemens and Halske's, Wheatstone's, Nollet's, Alliance, Holmes', Wilde's, and Gramme Magneto-Electric Machines. The Serrin and other Lamps. Jablochkoff's Candles. Experiments in Electric Illumination. Contained in SUPPLEMENTS **98, 99.** The Electric Illumination of MM. Sautter & Lemonnier's Workshops, Paris, with cost, and one illustration, in SUPPLEMENT **38.** A description of Jablochkoff's Electric Candle. SUPPLEMENTS **78, 108.** Price 10 cents each.

ILLUMINATION BY ELECTRICITY. BY J. Jarmin, de l'Academie des Sciences. How to Compare the Electric Arch to the Sun. The Electric Light Equal to the Sun. The Division of the Arch by the Alternative Currents of Le Roux. The Jablochkoff Candle. New and Remarkable Experiment of Jablochkoff. The Condenser in Electric Illumination. The Perfect Light required to contain all the Colors. Simple Methods of Preventing the Bluish effect of the Electric Light. No Heat from the Electric Light. The Noise from the Electric Light. Cost. Faults heretofore in Electric Lighting. How to produce General, or Diffused Illumination. SUPPLEMENT **132.** Price 10 cents.

THE TRANSMISSION OF POWER BY Electricity.—By N. S. Keith. Demonstrating the possibility of utilizing the power of waterfalls, etc., at long distances. Careful electrical computations, descriptions of necessary apparatus, and cost. SUPPLEMENT **87.** Price 10 cents.

ELECTRO-HARMONIC TELEGRAPHY. A paper read before the American Electrical Society, Chicago, by F. L. Pope. The Three Laws of the Pendulum explained. Vibrations of Chords, Bars, Plates, Membranes, and Gases. Undulations upon Liquids. How the Laws of the Pendulum govern all Vibrations and Undulations. The Mutual Convertibility of Vibrations and Undulations. How to Graphically Delineate Vibrations. What Sound is,

THE PHONOGRAPH.—LECTURE BY Prof. J. W. S. Arnold. What Sound is. Music and Noise. Construction of the Ear, and How we Hear. Vocal Sounds made Visible. The Lissajous Curves. Construction of the Phonograph, with Five Figures. SUPPLEMENT **119.** Price 10 cents.

VORTEX MOTION.—BY PROF. O. REYnolds.—A Lecture delivered at the Royal Institution. New Principle of Fluid Motion, and How Discovered. Characteristics of Smoke Rings, Eddies in Water, etc., and their Mathematical Relations. Nautical and other Applications, etc., with Beautiful Experiments. SUPPLEMENT **85.** Price 10 cents.

ZIRCONIA FOR THE OXY-HYDROGEN LIGHT.—By John C. Draper. The Difficulties attending the use of the Calcium Light for projecting Magnified Representations upon a screen from the Microscope. The success obtained by the substitution of a Zirconia Cylinder for the Calcium. What Zirconia is, and complete directions for preparing Cylinders. SUPPLEMENT **93.** Price 10 cents.

GRAPHICAL DETERMINATION OF the Volume and Surface of Bodies generated by Revolution.—By Walter G. Berg. Guldin's Rules, with Five Figures. SUPPLEMENT **108.** Price 10 cents.

EGYPTIAN OBELISKS AND THEIR Relation to Chronology and Art. By Basil H. Cooper. A Lecture before the Society of Arts, London. Egyptian Religious Ideas, and How the Form of the Obelisk expressed them. How the Monoliths were Quarried. How they were Transported. Incredible Engineering Feats. The Hieroglyphics and their Wonderful Interpretation by the Rosetta Stone. Interpretation of Chronological Eras. SUPPLEMENT

ROSE'S MACHINIST.

THE COMPLETE PRACTICAL MACHINIST:

Embracing Lathe Work, Vise Work, Drills and Drilling, Taps and Dies, Hardening and Tempering, the Making and Use of Tools, etc., etc. By Joshua Rose. Illustrated by 130 engravings. In one Volume, 12mo, 376 pages. Price $2.50.

CONTENTS.

CHAPTER I. LATHE AND MACHINE TOOLS.—Round-Nosed Tools; Square-Nosed Tools; Holding Tools; Side Tools for Iron; Front Tool for Brass Work; Side Tool for Brass Work. II. CUTTING SPEED AND FEED.—Tables of Cutting Speeds and Feeds; Table for Steel; Table for Wrought Iron; Table for Cast Iron; Table for Brass; Table for Copper. III. BORING TOOLS FOR LATHE WORK.—Boring Tool for Brass; Boring Tool Holders. IV. SCREW-CUTTING TOOLS.—Hand Chasing; To make a Chaser; To Calculate the Gear Wheels necessary to cut a Thread in a Lathe. V. GENERAL OBSERVATIONS ON LATHE WORK.—Lathe Dogs and Drivers; Emery Grinders; Centering Machine; Lathe Work; Emery Cloth and Paper. VI. TURNING ECCENTRICS.—Turning Cranks; To Chuck a Crosshead; Turning Pistons and Rods; Piston Rings; Ball Turning; Cone Plate for Boring in the Lathe; To turn a Pulley; Turning and Fitting Tapers; Belts; Oiling and Greasing of Belts; Directions for Calculating the Width of Belts required for Transmitting Different Numbers of Horse Power; Directions for Calculating the Number of Horse Power which a belt will Transmit, its Velocity and the Number of Square Inches in Contact with the Smallest Pulley being Known. VII. HAND TURNING.—Roughing Out; The Graver; The Heel Tool; Brass Work; Scrapers; Lathe Chucks. VIII. DRILLING IN THE LATHE.—Half-Round Bits; Cutters; Reamers; Shell Reamers. IX. BORING BARS.—Small Boring Bars. X. LAPS.—Allowance for Shrinkage; Crank Pins; Chucking Brasses; Slotting Machine Tools. XI. TWIST DRILLS.—Feeding Drills; Drills and Drilling—Flat Drills; Drilling Hard Metals; Slotting or Keyway Drills; Pin Drills; Countersink Drills. XII. TOOL STEEL.—Forging Tools; Tool Hardening and Tempering; Hardening; To Harden Springs; Case Hardening Wrought Iron; To Case Harden Cast Iron; To Harden Malleable Iron; The Crystallization of Wrought Iron; The Wear of Metal Surfaces; Annealing or Softening; Mixtures of Metals. XIII. TAPS AND DIES.—Adjustable Dies; Dies for Use in Hand Stocks. XIV. VISE WORK.—Tools.—Calipers; The Square; The Scribing Block; Chipping; Filing; Emery Paper; Tools for Scraping Surfaces; Vise Clamps; Pening; Fitting Brasses to their Boxes; Fitting Link Motions; Fitting Cylinders; Scraped Surfaces; To Make a Surface Plate; To Cut Hard Saw Blades; To Refit Leaky Plugs to their Cocks; Refitting Work by Shrinking it; To estimate the Weight of a Casting from the Weight of the Pattern; Grades and Speeds for Emery Wheels; Threads of Gas or Steam Pipes; Steam and Water Joints; To Make Spiral Springs; Hardening; Tempering. XV. FITTING CONNECTING RODS.—Drifts; Reverse Keys. XVI. MILLING MACHINES AND MILLING TOOLS. XVII. TO CALCULATE THE SPEED OF WHEELS, PULLEYS, ETC. XVIII. THE SLIDE VALVE.—Movements of Piston and Crank; Steam Supply; To Measure the Throw of an Eccentric. XIX. HOW TO SET A SLIDE VALVE. XX. PUMPS.—Suction Pumps; Force Pumps; Piston Pumps.—INDEX.

We also publish

The Modern Practice of American Machinists and Engineers. By E. P. Watson. Illustrated by 86 engravings. 12mo. $2.50

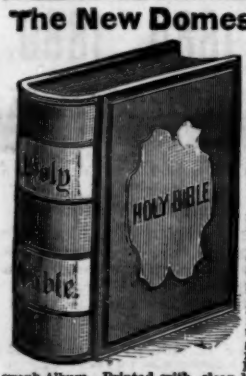
A Manual of the Hand Lathe. By E. P. Watson. Illustrated by 75 engravings. 12mo, . . $1.50

The above, or any of our Books, sent by mail, free of postage, at the publication price.

Our new and enlarged CATALOGUE OF PRACTICAL AND SCIENTIFIC BOOKS—96 pages, 8vo—and other Catalogues, sent free to any one who will furnish his address.

HENRY CAREY BAIRD & CO.,
Industrial Publishers, Booksellers, and Importers,
810 WALNUT STREET, Philadelphia.

The New Domestic Bible.



This splendid Royal Quarto Edition of the Bible is made self-explaining, being a Complete Library of the Holy Scriptures, and contains, in addition to the Old and New Testaments, Apocrypha, Concordance and Psalms, and nearly 2,000 Illustrations and 20 Full-Page Engravings; and 115 additional features, the most important of which are a Bible Dictionary, History of the books of the Bible, History of Religious Denominations, History of the nations, cities, rivers, lakes, birds, beasts, reptiles, insects, trees, fruits and flowers of the Bible, 100,000 marginal references, Marriage Certificate, Family Record and a Photograph Album. Printed, with clear, large type, on paper of first-class quality. Size of page, 10½ x 13¼ inches. The work is superbly bound in morrocco, massive raised panel, gilt-edge and back, and was sold two years ago at $15 per copy. We will send this work pre-paid upon receipt of price. The plates alone cost $11,000. We warrant this Bible to be a good as those sold for $15 in any bookstore. A Special Offer! For special reasons we agree, upon the receipt of $9, to pay the postage and other expenses, to send any reader of this paper a copy of the Holy Bible, with the superb work of art, produced in ten beautiful colors and richly illustrated, entitled "The Lord's Prayer." This is a RARE combination, and a big field for agents. This offer is good for 60 days only, and may not appear again. We send three copies for $22.75. Money may be sent at our risk in a plain letter. Name this paper. Order now, and address,

N. W. HUNT, Philadelphia, Penn.

Grain Stocks How to make Money rapidly and at once, trading in Grain and Stocks. A perfected system of combinations, the result of years of experience, most valuable information for all, sent free. Old, reliable, established Exchange. A competent business man as agent wanted in every county. Good pay. Address The Chicago Public Produce Exchange, Chicago, Ill.

50,000 Agents wanted by 1,000 advertisers in the Agents' Herald, Box 5, Philadelphia, Pa.

GREAT HOLIDAY OFFER!

Patent SPOONS, KNIVES, and FORKS made of English Steel, Nickel and Silver Plated, and highly finished,

WARRANTED TO LAST 15 YEARS!

We will send by mail or express, prepaid, any of the following articles at prices named:

12 Tablespoons (ornamented)	$1.50
12 Teaspoons (ornamented)	1.00
12 Table Forks (ornamented)	1.50
6 Table Knives (balance handle)	2.75
6 Tea Knives (balance handle)	2.50
1 Butter Knife (ornamented)	.50
1 Soup or Oyster Ladle (ornam'd)	1.25
1 Dinner Caster (ornamented)	4.00
Total	$15.00

Or Whole Set (51 pieces) $9.00

All sums over $1.00 should be sent in registered letter. ☞ *This Advertisement will not appear again.*
NORTHFORD SPOON CO., Mfrs., Northford, Conn.

Baker Rotary Pressure Blower.

(FORCED BLAST)

Warranted superior to any other.

WILBRAHAM BROS.
2315 Frankford Ave.
PHILADELPHIA

NEW YORK BELTING AND PACKING COMP'Y.

The Oldest and Largest Manufacturers of the Original

SOLID VULCANITE

EMERY WHEELS.

Emery Wheel.

All other kinds Imitations and Inferior. Our name is stamped in full upon all our standard BELTING, PACKING, and HOSE.

Address NEW YORK BELTING AND PACKING CO., NEW YORK.
JOHN H. CHEEVER, Treas.

PLAYS! PLAYS! PLAYS! PLAYS!

For Reading Clubs, for Amateur Theatricals, Temperance Plays, Drawing Room Plays, Fairy Plays, Ethiopian Plays, Guide Books, Speakers, Pantomimes, Tableaux Lights, Magnesium Lights, Colored Fire, Burnt Cork, Theatrical Face Preparations, Jarley's Wax Works, Wigs, Beards, and Moustaches at reduced prices. Costumes, Scenery, Charades. New catalogues sent free, containing full directions and prices.

SAMUEL FRENCH & SON, 38 E. 14th Street, New York.

SEND 10 CENTS IN U. S. POSTAGE STAMPS FOR Manual for Engineers and Steam Users, by John W. Hill, M.E., to WM. A. HARRIS, Providence, R. I.

SPARE THE CROTON AND SAVE THE COST.

Driven or Tube Wells

furnished to large consumers of Croton and Ridgewood Water. WM. D. ANDREWS & BRO., 235 Broadway, N.Y., who control the patent for Green's American Driven Well.

Steel Stamps.

N.Y. STENCIL WORKS 87 Nassau St. N.Y.

NIXON'S COPYING PAD.

A cheap, simple, and perfect method for the instant reproduction of 50 to 100 copies of any writing, drawing, etc. Electric Pen, Papyrograph, etc., completely outdone. Every one his own printer.

Post card size, 50c.; Note, 75c.; Letter, $1; Legal, $1.25, by mail, postage prepaid. Agents wanted.

ED. H. NIXON, 33 Maiden Lane, New York.

GEO. W. TIFFT, SONS & CO., BUFFALO, N. Y., Specialties 4 to 40 H. P. Engines and Boilers, Sugar Cooling Wagons, Machinery, Steam Kettles, etc.

ESTABLISHED 1821 — TIME TRIES ALL THINGS — CIRCULATION 40,000 — 1879

Everybody Read This!

NO MIDDLEMEN.

Save $50.00 in the purchase of a Sewing Machine, or work a day among your friends, and

PROCURE ONE FOR NOTHING.

"Unquestionably the most popular Machine in the market."

NEVER GETS OUT OF ORDER. ALWAYS READY FOR USE.

FOR MORE THAN HALF A CENTURY THE LEADING FAMILY PAPER OF AMERICA.

☞ *The Saturday Evening Post*, published at Philadelphia, Pa., is the oldest Literary and Family Paper in America—now in its 53d year. It is a large 16 page weekly paper, elegantly printed, folded, cut and bound. Subscription price only $1 a year, and its publishers have determined to spare no money in introducing it into households in *every city and hamlet* in the United States. In order to do this we have made arrangements with one of the largest manufacturers of Sewing Machines in the world to furnish us with a large number of the CELEBRATED LATEST STYLE GROVER & BAKER SEWING MACHINES *at a fraction above their actual cost of production.* We have been able to make this

UNPRECEDENTED ARRANGEMENT

by contracting for large numbers of Machines and paying the cash in advance for them, and we now offer to furnish a Machine to every person subscribing for the POST *at the actual cost to us*, thus saving to our subscribers the enormous profits heretofore and now made on Sewing Machines when sold through the regular channels of trade, in which event it is necessary for a Machine to pass through several hands, and the purchaser must pay to each a handsome profit. In the construction of the *Grover & Baker Machines*, old ideas have been discarded, and in accordance with the progressive spirit of the age, new combinations and devices have been used to make it a *Perfect Sewing Machine*, and we unhesitatingly recommend it to all. It is the same Machine that has been sold by *Agents at $65.* Each Machine is furnished complete, all having highly polished black walnut top and box cover that locks down, and the iron work is finished in *black and gold*, with nickle slide.

OUR OFFER.

On receipt of $16.00 we will mail, postage prepaid, a copy of the *Saturday Evening Post* for one year to any address in the United States, and also forward *on day money is received*, one of the above described Sewing Machines, securely boxed, to any town in the United States in which there is an express office, and prepay all express charges to destination, thus delivering to you a choice family paper for one year, and a Sewing Machine sold by former combinations at $65, and all *to you for only $16.* We also send free with each Machine the usual attachments, such as Guide, Guide Screw, Quilter, Hemmer, Oil Can, Screw Driver, 1 dozen assorted Machine Needles, a book of instructions, so that *any one* can run the Machine *without a teacher, &c.* Or to any person sending us the names of twenty new subscribers for the POST for one year, and enclosing $40.00, we will send a Machine as above with all attachments, FREE! You can send the name of five or more at a time, but state you are working for the Sewing Machine premium. Sample copies of the POST sent free on application. ☞ EVERY MACHINE GUARANTEED IN PERFECT RUNNING ORDER, OR MONEY WILL BE REFUNDED. Remember, everything in the above offer will be delivered to you ABSOLUTELY FREE after we have received $16.00, as all EXPRESS CHARGES ARE PREPAID BY US; we can only do this, by having made SPECIAL RATES with transportation companies.

As to our reliability, we refer to the publishers of ANY PHILADELPHIA JOURNAL, but we think it sufficient to say that the POST has been published for the past FIFTY-NINE YEARS, it has NEVER MISSED AN ISSUE, is favorably known throughout the *United States*, and we expect it to gladden the firesides of its thousands of readers for many years to come. When you order mention this magazine, write your name plainly, giving your post office and nearest express office. Send money by registered letter, post office money order, or draft on New York or Philadelphia, made payable to our order. Address all letters to the

PUBLISHERS SATURDAY EVENING POST,
No. 726 Sansom Street, Philadelphia, Pa.

N.B.—This cut represents the two-spool G. & B. Machine. If preferred we will send the lock-stitch shuttle Grover & Baker or Howe sewing machine at same price and on same terms.

Model Engines.

Complete sets of CASTINGS for making small Model Steam Engines 1 1-2 in. bore, 3in. stroke, price, $4; ditto 2 in. bore, 4 in. stroke, price, $10, same style as cut. Gear Wheels and Parts of Models. All kinds of Small Tools and Materials. Catalogue Free. GOODNOW & WIGHTMAN, 176 Washington Street, Boston, Mass.

Machinists, You are ruining Mechanics, & Manufacturers! your mach'ry by using injurious compounds, falsely represented to be Natural Lubricating Oils! Consumers can obtain from us pure *West Va. Oils, guaranteed* not to congeal in the coldest weather, in 2 gall. or 5 gall. cans, or by single barrel. These oils are produced from our own wells! Send for circular. E. W. STAPLES & CO., Volcano Wood Co., W. Va.

ORGAN BEATTY PIANO

New Uprights 13 Stops, 3 set Golden Tongue Reeds, 5 Octs., 3 Knee Swells, Walnut Case, warr'd 6 years, Stool & Book $98. New Pianos, $143 to $255. 67 Newspapers sent Free. Address Daniel F. Beatty, Washington, New Jersey.

PHOSPHOR-BRONZE

TRADE MARK

Phosphor-Bronze.

BEARINGS, PUMP-RODS, AND SPRING WIRE.

Apply to

THE PHOSPHOR-BRONZE SMELTING CO., Limited
208 Washington Ave., Philadelphia, Pa.

PHONOGRAPHIC CORNET.

The Latest and Greatest Musical Wonder.

The Phonographic Cornet is the latest invention in the musical line. The action of this instrument is almost marvellous. It plays the most complicated airs equal to a first-class Cornet solo. The picture represents the manner of playing; simply turning the little crank on the side produces most exquisite music. The music-producers are genuine first-class Organ Reeds, and the music itself is like that of a first-class Organ played on the high notes, with the flute stops out. *Any tunes that ever was written can be instantly played on the Phonographic Cornet*, **without any instruction or knowledge of music whatever** *by the operator.* A little strip of paper in which the tune has been perforated, is placed in the instrument, and then simply turning the little handle brings out the tune in a clear and extremely melodious manner. Selections of choice music accompany each "cornet." Any child can play this instrument; the music is very pleasing; all the new tunes can be easily obtained, and no musical instrument in the world can provide more genuine entertainment, at home or in company, than the Phonographic Cornet. **Anyone** can play it, and produce the latest music in a manner that will surprise everyone. The instruments are all strongly and elegantly made of fancy woods, ebonized trimmings, and silvered bells. They are packed in a neat case, with music strips, directions, &c., &c., and sent by express to any address for $25; by registered mail, prepaid, $26.50. Extra tunes, comprising all the latest popular music, are now ready.

Address THE MASSACHUSETTS ORGAN CO., 46 Washington Street, Boston, Mass.

PATENTS AT AUCTION

and at Private sale. Regular Monthly Sales. For terms, address N. Y. PATENT EXCHANGE, 67 Liberty Street, New York.

THE DRIVEN WELL.

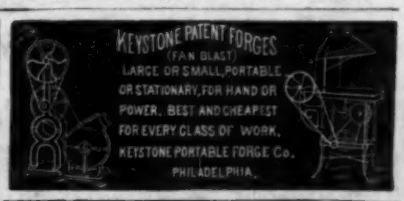
Town and County privileges for making Driven Wells and selling Licenses under the established American Driven Well Patent, leased by the year to responsible parties, by

WM. D. ANDREWS & BRO.,
235 BROADWAY, NEW YORK.

Pond's Tools,

Engine Lathes, Planers, Drills, &c.

DAVID W. POND, Worcester, Mass.



The George Place Machinery Agency

Machinery of Every Description.
121 Chambers and 108 Reade Streets, New York.

FOR SALE.—One Woodworth Planer, Plane and Groove 24 inches wide. HARRIS & FLINT, Danbury, Conn.

BLAKE'S STONE AND ORE BREAKER AND CRUSHER.

For breaking hard and brittle substances to any size. Endorsed by the leading Mining, Manufacturing, and Railroad corporations in the United States and Foreign Countries. First Premium wherever exhibited, and hundreds of testimonials of the *highest character.*

Indispensable for making best McAdam Roads, Ballasting of Railroads, Crushing the hardest Ores, Stone for Concrete, etc., etc. *Prices greatly reduced.*

Address BLAKE CRUSHER CO., New Haven, Conn.

LOOSE PULLEYS.

Self-lubricating, best in market. Send for circular and price list to W. OESTERLEIN, 18 Home St., Cincinnati, O.

Has More Good Points, Does More and Better Work, Takes Less Power, Than any Hammer in the World.

BRADLEY & COMPANY, SYRACUSE, N.Y.

WANTED.

A Second-hand Engine and Boiler, about one H. P. Must be in good repair and cheap. Address, stating condition and price, JOHN GRAY, Attleboro, Mass.

WANTED—SPOKE MACHINERY. SEND BY WHOM made, and lowest cash price to E. POWELL, Chapinville, N. Y.

SCRAP IRON AND OLD RAILS SUPplied, for cash, in quantities and of qualities to suit the American markets, by A. NORRINGTON & CO., 34 Great St. Helens, London, England. First-class references given.

WILD'S PATENT PIANO DANCERS.

A beautiful illustration of the transformation of *sound into motion*, and a very amusing toy. Attachment for Pianos. Prices, $1.00, $1.50, and $3.00. Send for descriptive circular to G. L. WILD & BRO., 723 Seventh Street, N. W., Washington, D. C.

WANTED.—A COMPLETE SET OF U. S. Patent Office Reports, or odd volumes. A fair cash price will be paid. Address GEO. C. TRACY & CO., Cleveland, Ohio.

FOR STEEP OR FLAT ROOFS — READY — ROOFING — SEND FOR SAMPLE AND CIRCULAR — W. H. STEWART — 74 COURTLAND ST. NEW-YORK.

ICE-BOATS — THEIR CONSTRUCTION and management. With working drawings, details, and directions in full. Four engravings, showing mode of construction. Views of the two fastest ice-sailing boats used on the Hudson river in winter. By H. A. Horsfall, M.E. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 1. The same number also contains the rules and regulations for the formation of ice-boat clubs, the sailing and management of ice-boats. Price 10 cents.

ICE-BOAT WHIFF.—FULL WORKING drawings and description, with dimensions of the model ice-yacht Whiff, the fastest yacht in the world. Exhibited at the Centennial, by Irving Grinnell. With 14 illustrations. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, 63. Price 10 cents. To be had at this office and at all news stores. Any intelligent person, with the aid of the drawings and directions given in the above numbers of the SUPPLEMENT, may readily construct a first-class ice-boat, of any desired size, at a small cost.

MAGIC LANTERN

WITH 36 VIEWS $12.00

CATALOGUES FREE — THEO. J. HARBACH — 809 FILBERT ST. PHILA. PA.

To Electro-Platers.

BATTERIES, CHEMICALS, AND MATERials, in sets or single, with Books of Instruction for Gold, Silver, or Nickel Plating. THOMAS HALL, Manufacturing Electrician, 19 Bloomfield Street, Boston, Mass. Illustrated Catalogue sent free.

BEATTY'S TOUR in EUROPE.

ONLY 10 cents. Being a condensed history and travels in Europe. Over 50 engravings, nearly 100 pages, nicely bound book sent for only 10 cents. Address the Author & Publisher, DANIEL F. BEATTY, Washington, New Jersey.

Paris, . . 1878
Australia, 1877
Phila., . . 1876
Santiago, 1875
Vienna, . 1873

J. A. FAY & CO'S

WOOD WORKING MACHINERY

was awarded at the Paris Exposition over all competitors THE GOLD MEDAL OF HONOR. Also highest award at Phila., Santiago, Australia, and Vienna. It is

Original in Design. Simple in Construction, Perfect in Workmanship. Saves labor, Economizes lumber, and Increases products of the highest standard of Excellence.

Railroad, Furniture, and Agricultural Implement Shops, Planing Mills, etc., equipped at short notice, and the lowest cash prices. Send for Circulars.

J. A. FAY & CO., Cincinnati, Ohio, U. S. A.

FIRE BRICK, TILE AND CLAY RETORTS ALL SHAPES. BORGNER & O'BRIEN 23 RD ST. ABOVE RACE PHILADELPHIA

Shafts, Pulleys, Hangers, Etc.

Full assortment in store for immediate delivery.

WM. SELLERS & CO.,
79 Liberty Street, New York.

Advertisements.

Inside Page, each insertion - - - 75 cents a line.
Back Page, each insertion - - - $1.00 a line.
(About eight words to a line.)

Engravings may head advertisements at the same rate per line, by measurement, as the letter press. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

☞ The publishers of this paper guarantee to advertisers a circulation of not less than 50,000 copies every weekly issue.

JAMES ECCLES,
General Machinist, Inventor, and Maker of the
Patent Quadruple Screw Power Press
For the use of Printers, Hosiery Manufacturers, and all others who desire great and uniform pressure.
2423 Lombard St., Philadelphia, Pa.
ESTABLISHED 1855.

Gear Molding without Patterns
Scott's Gear Moulding Machines,
AIR COMPRESSORS & ROCK DRILLS.
DELAMATER IRON WORKS,
Boiler Makers, Engine Builders, and Founders,
FOOT OF W. 13th ST., North River, NEW YORK.
ESTABLISHED 1841.

THE PICTET
ARTIFICIAL ICE COMPANY, Limited.
Ice Machines to make from 20 pounds per hour to 50 tons per day, at 36 Cortlandt St., New York. P. O. Box 3883.

SHAFTING, PULLEYS, HANGERS, ETC.,
of superior quality, a specialty. P. PRYIBIL,
461-467 West 40th Street, New York.

BRADFORD MILL CO.
Successors to Jas. Bradford & Co.,
MANUFACTURERS OF
French Buhr Millstones, Portable Corn & Flour Mills, Smut Machines, etc.
Also, dealers in Belting Cloths and General Mill Furnishings.
Office & Factory, 152 W. 2d St.
CINCINNATI, O.
J. B. Stewart, Pres. W. B. Dunlap, Sec.
☞ PRICE LISTS SENT ON APPLICATION.

IT PAYS to sell our Rubber Hand Printing Stamps. Circulars free. G. A. HARPER & BRO., Cleveland, O.

Warning.—*The Process of "Elastic Transfer Printing."* J. M. Jacobs, having secured by assignment Letters Patent of the U. S. No. 105,300, for the process of "Elastic Transfer Printing," cautions the public against purchasing any of the Grams, Graphs, or Tablets now being offered in the market, as the same are direct infringements on his patent, and injunction will follow. In order that all shall test the merits of the improved Jacobs Patent Lithogram, the following reduced prices have been established: Post, $1.50; Note, 75; Letter, 85; Legal, 37; Folio, 20. 50 impressions from one original writing. J. M. JACOBS, 3 Arch Street, Boston, Mass.

H.W.JOHNS' ASBESTOS
Liquid Paints, Roofing, Boiler Coverings, Steam Packing, Sheathings, Fire Proof Coatings, Cements, &c. Send for Descriptive Price List.
H.W. JOHNS M'F'G CO. 87 MAIDEN LANE, N.Y.

Cigar Box Lumber,
MANUFACTURED by our NEW PATENT PROCESS.
The Best in the World.
SPANISH CEDAR,
MAHOGANY,
POPLAR.
Also Thin Lumber of all other kinds, ⅛ to ½ in., at corresponding prices. All qualities. Equal in all respects to any made, and at prices much under any to be obtained outside of our establishment. Send for price list.
GEO. W. READ & CO.,
186 to 200 Lewis Street, N. Y.

WATCHMAN'S IMPROVED
Time Detector, with Safety Lock Attachment. Send for circular to E. IMHAUSER, 212 Broadway, P. O. Box 2875, New York. Beware of buying infringing detectors.

Mill Stones and Corn Mills.
We make Burr Millstones, Portable Mills, Smut Machines, Packers, Mill Picks, Water Wheels, Pulleys, and Gearing specially adapted to Flour Mills. Send for catalogue.
J. T. NOYE & SON, Buffalo, N. Y.

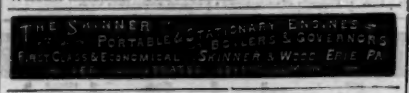
The attention of Architects, Engineers, and Builders is called to the great decline in prices of wrought
STRUCTURAL IRON.
It is believed that, were owners fully aware of the small difference in cost which now exists between iron and wood, the former, in many cases, would be adopted, thereby saving *insurance* and avoiding all risk of *interruption to business* in consequence of fire. Book of detailed information furnished on application.

$10 to $1000 Invested in Wall St. Stocks makes fortunes every month. Book sent free explaining everything. Address BAXTER & CO., Bankers, 7 Wall St., New York.

GOULD'S HAND AND POWER PUMPS should be used by every household, factory, railroad, steamboat, or mine, and will give satisfaction. They make them for all purposes and uses. Illustrated catalogues furnished upon application. Kept by all dealers throughout the country. THE GOULDS M'F'G CO., Factory, Seneca Falls, N. Y. Warehouse, 15 Park Pl., N.Y. ☞ *Inquire for Goulds' Pumps.*

J. LLOYD HAIGH,
Manufacturer of
WIRE ROPE
of every description, for Railroad and Mining Use, Elevators, Derricks, Rope Tramways, Transmission of Power, etc. No. 81 John St., N. Y. Send for price list. Plans and Estimates furnished for Suspension Bridges.

STEAM PUMPS.
HENRY R. WORTHINGTON,
239 Broadway, N. Y. 83 Water St., Boston.
THE WORTHINGTON DUPLEX PUMPING ENGINES FOR WATER WORKS—Compound, Condensing or Non-Condensing. Used in over 100 Water-Works Stations.
STEAM PUMPS—Duplex and Single Cylinder.
Price list issued Jan. 1, 1879, with a reduction exceeding 30 per cent.
WATER METERS. OIL METERS.



HARTFORD
STEAM BOILER
Inspection & Insurance
COMPANY.
W. B. FRANKLIN, V. Pres't. J. M. ALLEN, Pres't.
J. B. PIERCE, Sec'y.

SEND FOR ILLUSTRATED CATALOGUE of Mathematical Instruments and Materials indispensable to Millwrights, Millers, Mechanics, and Artisans. Address
KAY & BRO., Publishers, Springfield, Ohio.

CENTENNIAL AND PARIS MEDALS.
Mason's Friction Clutches and Elevators.
"New and Improved Patterns."
VOLNEY W. MASON & CO., Providence, R. I., U. S. A.

THE FORSTER-FIRMIN GOLD AND SILVER AMALGAMATING COMP'Y of Norristown, Pa., will grant state rights or licenses on easy terms. This system works up to assay, and recovers the mercury rapidly. Apply as above.

Pyrometers, For showing heat of Ovens, Hot Blast Pipes, Boiler Flues, Superheated Steam, Oil Stills, etc.
HENRY W. BULKLEY, Sole Manufacturer,
149 Broadway, N. Y.

A GOOD PLAN. Combining and operating many orders in one vast sum has every advantage of greatest capital, with best skillful management. Large profits divided pro rata on investments of $25 to $10,000. Circular, with full explanations how all can succeed in stock dealings, mailed free. LAWRENCE & CO., 55 Exchange Place, New York.

SHAFTING, PULLEYS, HANGERS, etc.
a specialty. Send for Price List to
A. & F. BROWN, 57-61 Lewis Street, New York.

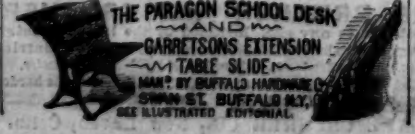
STEAM HEATING APPARATUS
LIGHT'S PATENTS
24 SIZES OF BOILERS RADIATION 25 PER CENT SUPERIOR TO ANY OTHER
ADDRESS EUREKA STEAM HEATING CO
ROCHESTER N.Y.

JOHN R. WHITLEY & CO.
European Representatives of American Houses, with First-class Agents in the principal industrial and agricultural centers and cities in Europe. London, 7 Poultry, E. C. Paris, 8 Place Vendôme. Terms on application. J. R. W. & Co. purchase Paris goods on commission at shippers' discounts.

Wood-Working Machinery,
Such as Woodworth Planing, Tonguing, and Grooving Machines, Daniel's Planers, Richardson's Patent Improved Tenon Machines, Mortising, Moulding, and Re-Saw Machines, Eastman's Pat. Miter Machines, and Wood-Working Machinery generally. Manufactured by
WITHERBY, RUGG & RICHARDSON,
26 Salisbury Street, Worcester, Mass.
(Shop formerly occupied by R. BALL & CO.)

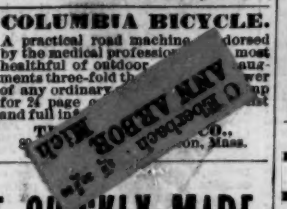
SCIENTIFIC AMERICAN SUPPLEMENT.
Any desired back number of the SCIENTIFIC AMERICAN SUPPLEMENT can be had at this office for 10 cents. May also be had or ordered through booksellers and newsdealers everywhere. MUNN & CO., Publishers,
37 Park Row, New York.

A HOUSEHOLD NECESSITY,
Of Great Merit and Thoroughly Tested.
Our Improved Roofing
CEMENT PAINT
Is specially adapted for the use of those who are not mechanics. Any farmer with this paint can effectually stop leaks around chimneys or scuttles, or in any portion of a roof (whether of wood, canvas, or tin), where all other methods have failed. Used for 16 years with great success as a roofing for cars, locomotive cabs, stages, etc. It is very elastic and durable; is unaffected by heat or cold; adheres firmly to metal, wood, or stone, and very simple in application. In 25 lb. boxes, ready for use, $5. 100 lb. boxes, $18.
Responsible Agents Wanted.
R. D. WASHBURN MANUF'G CO.,
Manuf'rs of Improved Builders' Hardware,
151 & 153 Congress Street, Boston, Mass.



MACHINISTS' TOOLS.
NEW AND IMPROVED PATTERNS.
Send for new illustrated catalogue.
Lathes, Planers, Drills, &c.
NEW HAVEN MANUFACTURING CO.,
New Haven, Conn.

COLUMBIA BICYCLE.
A practical road machine, indorsed by the medical profession as the most healthful of outdoor exercises. Improvements three-fold the power of any ordinary ... over of any ordinary ... up for 24 page ... list and full in...
T... CO.,
8... ton, Mass.



FORTUNE QUICKLY MADE.
Money has been made more rapidly within the last few months in Wall Street than at any period since 1873. Immense profits have been realized from small investments. The following affidavit explains itself:
Personally appeared before me, George A. Payne, of 134 West 49th Street, New York city, to me known, and, on being duly sworn, says that on an investment of $25 placed with Thatcher, Belmont & Co., bankers, and by them operated for a period of two weeks, I had returned to me by the said firm $972.50.
(Signed) GEO. A. PAYNE.
State of New York, City and County of New York, } ss.
Sworn before me this 22d September, 1879.
J. B. NONES, Notary Public, 91 Duane Street, N. Y.
Thatcher, Belmont & Co., accept subscribers on their 1 per cent. margin or in their concentration of capital, whereby a number of small sums, from $10 upwards, are aggregated and stocks operated. Latest Wall Street information sent free upon application by Messrs. Thatcher, Belmont & Co., Bankers, P. O. Box 1305, or 48 Broad Street, New York.

PATENT
COLD ROLLED SHAFTING.
The fact that this shafting has 15 per cent. greater strength, a finer finish, and is truer to gauge, than any other in use renders it undoubtedly the most economical. We are also the sole manufacturers of the CELEBRATED COLLINS' PAT. COUPLING, and furnish Pulleys, Hangers, etc., of the most approved styles. Price list mailed on application to JONES & LAUGHLINS,
Try Street, 3d and 3d Avenues, Pittsburg, Pa.
190 S. Canal Street, Chicago, Ill.
☞ Stocks of this shafting in store and for sale by FULLER, DANA & FITZ, Boston, Mass.
Geo. Place Machinery Agency, 121 Chambers St., N. Y.

$77 a Month and expenses guaranteed to Agents. Outfit free. SHAW & CO., AUGUSTA, MAINE.

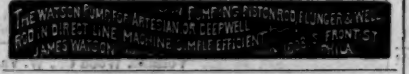
WOOD ENGRAVING AT PROCESS RATES AND IN much less time. T. P. Donaldson, 41 Park Row, N. Y.

Dead Stroke Power Hammers
are superior to all others for forging and die work. Over 500 now in use. Manufactured by
PHILIP S. JUSTICE,
14 North 5th Street, Philadelphia, Pa.

Holly's Improved Water Works.
Direct Pumping Plan. Combines, with other advantages, over older systems, the following: 1. Secures by variable pressure a more reliable water supply for all purposes. 2. Less cost for construction. 3. Less cost for maintenance. 4. Less cost for daily supply by the use of Holly's Improved Pumping Machinery. 5. Affords the best fire protection in the world. 6. Largely reduces insurance risks and premiums. 7. Dispenses with fire engines, in whole or in part. 8. Reduces fire department expenses. For information by descriptive pamphlet, or otherwise, address the
HOLLY MANUFACTURING CO., Lockport, N. Y.

DIES FOR EVERY PURPOSE.
STILES & PARKER PRESS CO., Middletown, Ct.

BOGARDUS' PATENT UNIVERSAL ECCENTRIC MILLS—For grinding Bones, Ores, Sand, Old Crucibles, Fire Clay, Guanos, Oil Cake, Feed, Corn, Corn and Cob, Tobacco, Snuff, Sugar, Salts, Roots, Spices, Coffee, Cocoanut, Flaxseed, Asbestos, Mica, etc., and whatever cannot be ground by other mills. Also for Paints, Printers' Inks, Paste Blacking, etc. JOHN W. THOMSON, successor to JAMES BOGARDUS, corner of White and Elm Sts., New York.



LARGE EQUATORIAL
16-inch aperture *Telescope*, with the *Observatory* and *Apparatus*, formerly belonging to *Samuel Young, Esq.*, Brincliffe Edge, Sheffield, England, for sale by private contract in consequence of the death of the owner.

EXTRACT FROM REPORT BY MR. JOHN BROWNING.

"The instrument has an *Object Glass* 16 inches diameter, mounted on an *Equatorial Stand*, by Slater, and has an independent movable hour circle to obviate calculation in finding; the hour circle reads to single minutes, the declination circle is by Simms, and is divided on silver to be read to 10 seconds; this circle has four verniers to eliminate eccentricity, those being all provided with reading microscopes.

"The *Telescope* has an excellent *Finder*, with an *Object Glass* 3 inches in diameter, of very short focus.

"The *Driving Clock* has a circular pendulum. There is a complete battery of eyepieces of magnifying powers varying from 60 to 900 diameters, and a large diagonal eyepiece for conveniently observing stars when in the zenith.

"The large *Object Glass* being of unusually short focus, the Telescope is admirably adapted for use with a *Spectroscope*, either for observing stellar spectra or solar prominence. There is a *Star Spectroscope* of my own make, which is fitted to the instrument.

"The dome of the *Observatory* has a double motion to a circular rack, and the line ring runs on balls.

"Both the *Equatorial* and the *Observatory* are in excellent condition, and can be handled easily by one person."

For particulars, apply to YOUNGE, WILSON & CO., Solicitors, Sheffield, England.

Leffel Water Wheels,
With recent improvements.
Prices Greatly Reduced.
8000 in successful operation.
FINE NEW PAMPHLET FOR 1879,
Sent free to those interested.
James Leffel & Co.,
Springfield, O.
110 Liberty St., N. Y. City.

"The 1876 Injector."
Simple, Durable, and Reliable. Requires no special valves. Send for illustrated circular.
WM. SELLERS & CO., Phila.

THE TANITE CO.,
STROUDSBURG, PA.
EMERY WHEELS AND GRINDERS.
LONDON—9 St. Andrews St., Holborn Viaduct, E. C.
LIVERPOOL—42 The Temple, Dale St.

ROCK DRILLING MACHINES AND AIR COMPRESSORS
MANUFACTURED BY BURLEIGH ROCK DRILL CO.
SEND FOR PAMPHLET FITCHBURG MASS.

FRIEDMANN'S PATENT
EJECTORS
Are the cheapest and most effective machines in the market for
Elevating Water and Conveying Liquids
from Mines, Quarries, Ponds, Rivers, Wells, Wheel Pits; for use in R. R. Water Stations, Factories, etc. They are splendidly adapted for conveying liquids in Breweries, Distilleries, Sugar Refineries, Paper Mills, Tanneries, Chemical Works, etc. Send for illus. catalogue to
NATHAN & DREYFUS,
Sole Manufacturers, NEW YORK.

$3 Printing Press
Prints cards labels &c. (Self-inker $5) 1⅝ larger sizes. For business or pleasure, young or old. Do your own advertising and printing. Catalogue of presses, type, cards, &c., for 2 stamps. Kelsey & Co. Meriden, Conn

Lathes, Planers, Shapers
Drills, Bolt and Gear Cutters, Milling Machines. Special Machinery. E. GOULD & EBERHARDT, Newark, N. J.

WM. A. HARRIS,
PROVIDENCE, R. I. (PARK STREET),
Six minutes walk West from station.
Original and Only builder of the
HARRIS-CORLISS ENGINE
With Harris' Patented Improvements,
from 10 to 1,000 H. P.

SHEPARD'S CELEBRATED
$50 Screw Cutting Foot Lathe.
Foot and Power Lathes, Drill Presses, Scrolls, Circular and Band Saws, Saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers, etc. Send for catalogue of outfits for amateurs or artisans.
H. L. SHEPARD & CO.,
331, 333, 335, & 337 West Front Street, Cincinnati, Ohio.

1880. 1880. 1880.
The Scientific American
FOR 1880.
THIRTY-FIFTH YEAR.
VOLUME XLII. NEW SERIES.

The publishers of the SCIENTIFIC AMERICAN beg to announce that on the Third day of January, 1880, a new volume will be commenced. It will continue to be the aim of the publishers to render the contents of the new volume as attractive and useful as any of its predecessors.

Only $3.20 a Year including Postage. Weekly. 52 Numbers a Year.

This widely circulated and splendidly illustrated paper is published weekly. Every number contains sixteen pages of useful information, and a large number of original engravings of new inventions and discoveries, representing Engineering Works, Steam Machinery, New Inventions, Novelties in Mechanics, Manufactures, Chemistry, Electricity, Telegraphy, Photography, Architecture, Agriculture, Horticulture, Natural History, etc.

All Classes of Readers find in THE SCIENTIFIC AMERICAN a popular *resume* of the best scientific information of the day; and it is the aim of the publishers to present it in an attractive form, avoiding as much as possible abstruse terms. To every intelligent mind, this journal affords a constant supply of instructive reading. It is promotive of knowledge and progress in every community where it circulates.

Terms of Subscription.—One copy of THE SCIENTIFIC AMERICAN will be sent for *one year*—52 numbers—postage prepaid, to any subscriber in the United States or Canada, on receipt of **three dollars and twenty cents** by the publishers; six months, $1.60; three months, $1.00.

Clubs.—One extra copy of THE SCIENTIFIC AMERICAN will be supplied gratis *for every club of five subscribers* at $3.20 each; additional copies at same proportionate rate. Postage prepaid.

One copy of THE SCIENTIFIC AMERICAN and one copy of THE SCIENTIFIC AMERICAN SUPPLEMENT will be sent for one year, postage prepaid, to any subscriber in the United States or Canada, on receipt of *seven dollars* by the publishers.

The safest way to remit is by Postal Order, Draft, or Express. Money carefully placed inside of envelopes, securely sealed, and correctly addressed, seldom goes astray, but is at the sender's risk. Address all letters and make all orders, drafts, etc., payable to
MUNN & CO.,
37 Park Row, New York.

To Foreign Subscribers.—Under the facilities of the Postal Union, the SCIENTIFIC AMERICAN is now sent by post direct from New York, with regularity, to subscribers in Great Britain, India, Australia, and all other British colonies; to France, Austria, Belgium, Germany, Russia, and all other European States; Japan, Brazil, Mexico, and all States of Central and South America. Terms, when sent to foreign countries, Canada excepted, $4, gold, for SCIENTIFIC AMERICAN, 1 year; $9, gold, for both SCIENTIFIC AMERICAN and SUPPLEMENT for 1 year. This includes postage, which we pay. Remit by postal order or draft to order of Munn & Co., 37 Park Row, New York.

THE "Scientific American" is printed with CHAS. ENEU JOHNSON & CO.'S INK. Tenth and Lombard Sts., Philadelphia, and 50 Gold St., New York.